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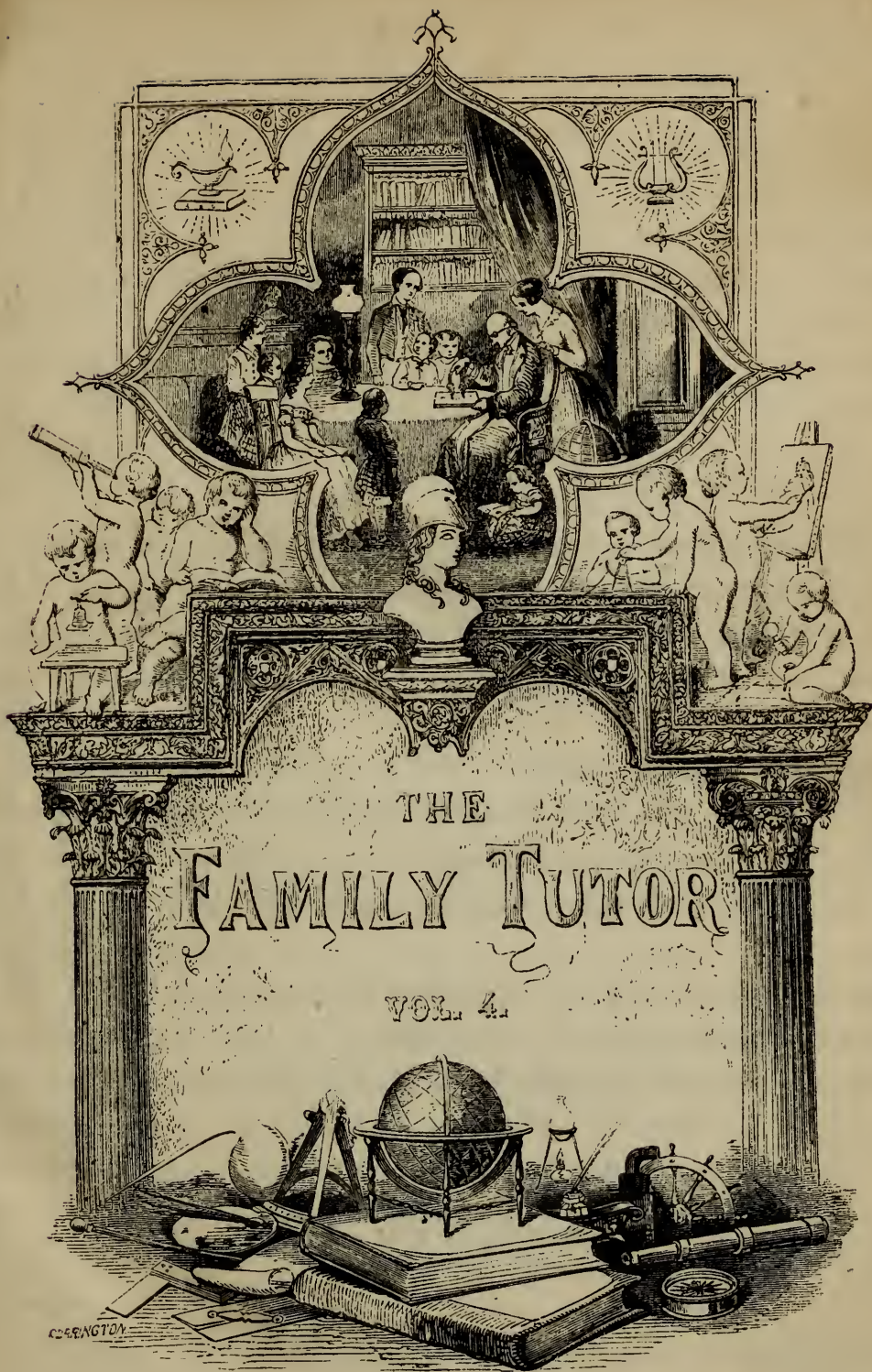
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J. E. Hamlin







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## PREFACE TO THE FOURTH VOLUME.

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It gives us much satisfaction to place our Fourth complete Volume before the Reader. The assurances we are constantly receiving of the beneficial influence of THE TUTOR in Families and in Schools afford us very great pleasure, and encourage us to persevere in our useful mission.

Our Series now consists of Four Volumes, including the careful treatment of English Grammar, Physical Geography, Geology, and Astronomy. In addition to these subjects in their complete form, will be found a copious Miscellany, embracing almost every subject of popular Education.

We venture to assert, that THE FAMILY TUTOR stands alone in these particulars,—that there is no other work so cheap, compact, yet comprehensive, and authentic. It is eminently adapted to the use of Families and Schools, as a work which makes learning a pleasure to the young as well as to those of riper years, whose early advantages were few, or those who may require from time to time to refresh their memories upon those subjects without a knowledge of which life is shorn of half its pleasures.

The FAMILY TUTOR and the FAMILY FRIEND are now superintended by the same Editor—the one who projected them both, and launched them into that extensive sphere of usefulness in which they have successfully ministered to the public good.

With regard to our future Volume, we intend to make "NATURAL PHILOSOPHY," by Dr. DRAPER, the leading subject. To this will be added, papers upon "THE FIRST PRINCIPLES OF CHEMISTRY," by Professor B. SILLIMAN. A system of ELOCUTION, with special reference to Gesture, to the treatment of Stammering, and Defective Articulation, by ANDREW COMSTOCK, together with a course of LESSONS IN FRENCH. These subjects will extend through Two VOLUMES, and be varied by Miscellaneous matters calculated to form an allurements to the subjects systematically treated.

Of our ally in the cause of human improvement, THE FAMILY FRIEND, we take the privilege of announcing here, that in No. 27,—the first Number of the Third Volume of the New Series,—will be commenced a NEW TALE, by MRS. ELLIS, the distinguished Authoress of "Family Secrets," "The Women of England," "The Voice from the Vintage," &c., &c., entitled

"THE MOTHER'S MISTAKE."

The Tale will be beautifully illustrated, by ANELAY.

We have no doubt that this announcement will carry the FRIEND into many additional thousands of English homes. Great as its popularity has already been, it will rise into pre-eminent favour.

We thank our pupils for their encouraging support; and still devoting ourselves with our best ability to their highest interests, we again take our leave.

LONDON, Dec. 13, 1852.



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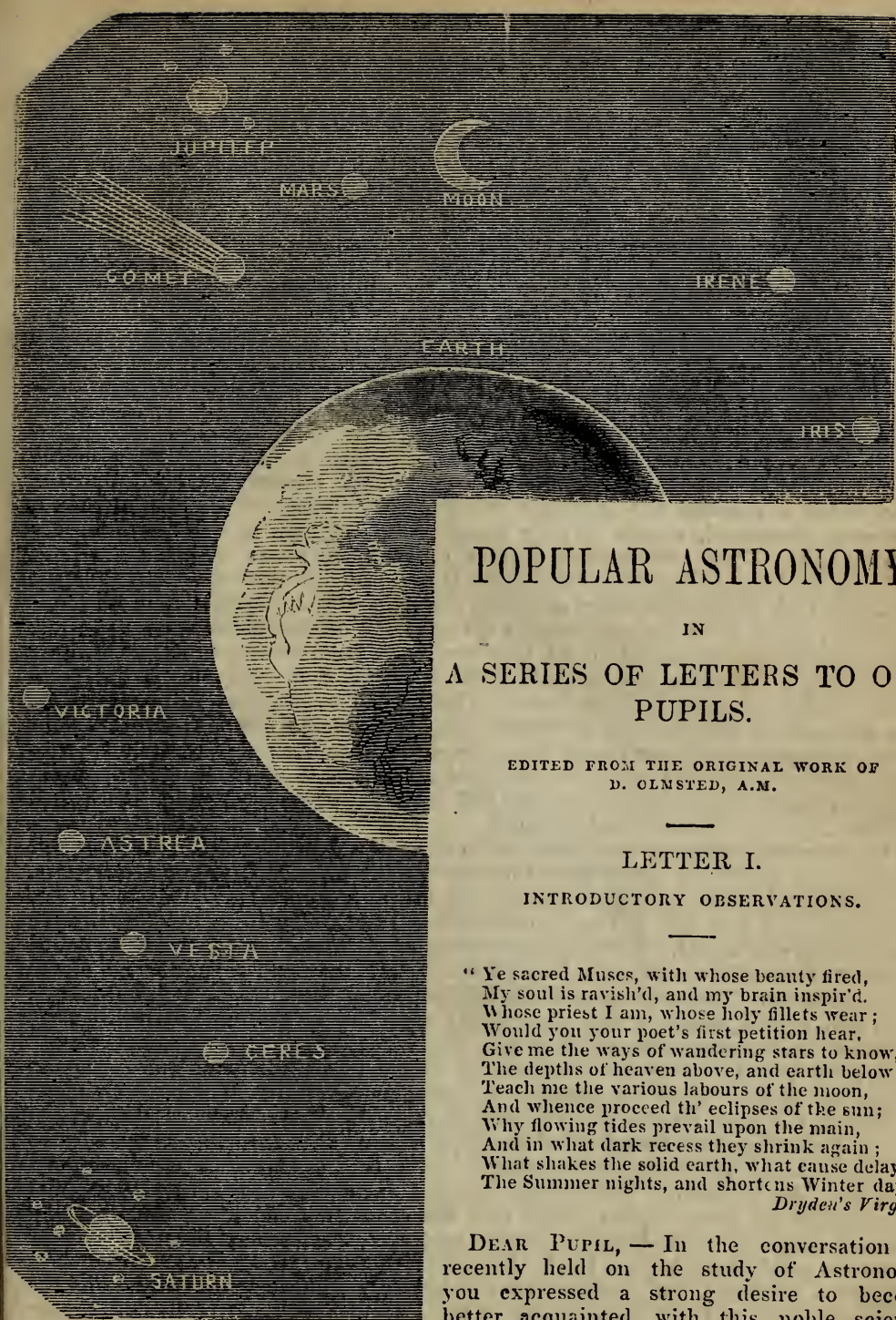
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# POPULAR ASTRONOMY,

IN

## A SERIES OF LETTERS TO OUR PUPILS.

EDITED FROM THE ORIGINAL WORK OF  
D. OLNSTED, A.M.

### LETTER I.

#### INTRODUCTORY OBSERVATIONS.

"Ye sacred Muses, with whose beauty fired,  
My soul is ravish'd, and my brain inspir'd.  
Whose priest I am, whose holy fillets wear;  
Would you your poet's first petition hear,  
Give me the ways of wandering stars to know,  
The depths of heaven above, and earth below;  
Teach me the various labours of the moon,  
And whence proceed th' eclipses of the sun;  
Why flowing tides prevail upon the main,  
And in what dark recess they shrink again;  
What shakes the solid earth, what cause delays  
The Summer nights, and shortens Winter days?"  
*Dryden's Virgil.*

DEAR PUPIL, — In the conversation we recently held on the study of Astronomy, you expressed a strong desire to become better acquainted with this noble science,

but said you had always been repelled by the air of severity which it exhibits, arrayed as it is in so many technical terms, and such abstruse mathematical processes: or, if you had taken up some smaller treatise, with the hope of avoiding these perplexities, you had always found it so meagre and superficial, as to afford you very little satisfaction. You asked if a work might not be prepared which would convey to the general reader some clear and adequate knowledge of the great discoveries in

astronomy, and yet require for its perusal no greater preparation than may be presumed of every English scholar of either sex.

You were pleased to add the request, that I would write such a work,—a work which should combine, with a luminous exposition of the leading truths of the science, some account of the interesting historical facts with which it is said the records of astronomical discovery abound. Having, moreover, heard much of the grand discoveries which, within the last fifty years, have been made among the *fixed stars*, you expressed a strong desire to learn more respecting these sublime researches. Finally, you desired to see the argument for the existence and natural attributes of the Deity, as furnished by astronomy, more fully and clearly exhibited, than is done in any work which you have hitherto perused. In the preparation of the proposed treatise, you urged me to supply, either in the text or in notes, every *elementary principle* which would be essential to a perfect understanding of the work.

Astronomy is a very difficult or a comparatively easy study, according to the view we take of it. The investigation of the great laws which govern the motions of the heavenly bodies has commanded the highest efforts of the human mind; but profound truths, which it required the mightiest efforts of the intellect to disclose, are often, when once discovered, simple in their complexion, and may be expressed in very simple terms. Thus, the creation of that element, on whose mysterious agency depend all the forms of beauty and loveliness, is enunciated in these few monosyllables, “And God said, let there be light, and there was light;” and the doctrine of universal gravitation, which is the key that unlocks the mysteries of the universe, is simply this,—that every portion of matter in the universe tends towards every other. The three great laws of the motion, also, are, when stated, so plain, that they seem hardly to assert anything but what we knew before. That all bodies, if at rest, will continue so, as is declared by the first law of motion, until some force moves them; or, if in motion, will continue so, until some force stops them, appears so much a matter of course, that we can at first hardly see any good reason why it should be dignified with the title of the first great law of motion; and yet it contains a truth which it required profound sagacity to discover and expound.

It is, therefore, a pleasing consideration to those who have not either the leisure or the ability to follow the astronomer through the intricate and laborious processes, which conducted him to his great discoveries, that they may fully avail themselves of the *results* of this vast toil, and easily understand truths which it required ages of the severest labour to unfold. The descriptive parts of astronomy, or what may be called the natural history of the heavens, is still more easily understood than the laws of the celestial motions. The revelations of the telescope, and the wonders it has disclosed in the sun, in the moon, in the planets, and especially in the fixed stars, are facts not difficult to be understood, although they may affect the mind with astonishment.

The great practical purpose of astronomy to the world is, enabling us safely to navigate the ocean. There are indeed many other benefits which it confers on man; but this is the most important. If, however, you ask, what advantages the study of astronomy promises as a branch of education, I answer, that few subjects promise to the mind so much profit and entertainment. It is agreed by writers on the human mind, that the intellectual powers are enlarged and strengthened by the habitual contemplation of great objects, while they are contracted and weakened by being constantly employed upon little or trifling subjects. The former elevate, the latter depress the mind to their own level. Now, everything in astronomy is great. The magnitudes, distances, and motions, of the heavenly bodies; the amplitude of the firmament itself; and the magnificence of the orbs with which it is lighted, supply exhaustless materials for contemplation, and stimulate the mind to its noblest efforts. The emotion felt by the astronomer is not that sudden excitement or ecstasy which wears out life, but it is a continued glow of exalted feeling, which gives the sensation of breathing in a purer atmosphere than others enjoy. We should at first imagine, that a study which calls upon its votaries for the severest efforts of the human intellect, which demands the undivided toil of years, and which robs the night of its accustomed



hours of repose, would abridge the period of life; but it is a singular fact, that distinguished astronomers, as a class, have been remarkable for longevity.

It is the privilege of the student of this department of Nature that his cabinet is already collected, and is ever before him; and he is exempted from the toil of collecting his materials of study and illustration, by traversing land and sea, or by penetrating into the depths of the earth. Nor are they in their nature frail and perishable. No sooner is the veil of clouds removed, that occasionally conceals the firmament by night, than his specimens are displayed to view, bright and changeless. The renewed pleasure which he feels, at every new survey of the constellations, grows into an affection for objects which have so often ministered to his happiness. His imagination aids him in giving them a personification, like that which the ancients gave to the constellations (as is evident from the names which they have transmitted to us); and he walks abroad, beneath the evening canopy, with the conscious satisfaction and delight of being in the presence of old friends. This emotion becomes stronger when he wanders far from home. Other objects of his attachment desert him; the face of society changes; the earth presents new features; but the same sun illumines the day, the same moon adorns the night, and the same bright stars still attend him.

When, moreover, the student of the heavens can command the aid of telescopes, of higher and higher powers, new acquaintances are made every evening. The sight of each new member in the starry train, that the telescope successively reveals to him, inspires a peculiar emotion of pleasure; and he at length finds himself, whenever he sweeps his telescope over the firmament, greeted by smiles, unperceived and unknown to his fellow-mortals. The same personification is given to these objects as to the constellations, and he seems to himself, at times, when he has penetrated into the remotest depths of ether, to enjoy the high prerogative of holding converse with the celestials.

It is no small encouragement, to one who wishes to acquire a knowledge of the heavens, that the subject is embarrassed with far less that is technical than most other branches of natural history. Having first learned a few definitions, and the principal circles into which, for convenience, the sphere is divided, and receiving the great laws of astronomy on the authority of the eminent persons who have investigated them, you will find few hard terms, or technical distinctions, to repel or perplex you; and you will, I hope, find that nothing but an intelligent mind and fixed attention are requisite for perusing the Letters which I propose to address to you. I shall indeed be greatly disappointed, if the perusal does not inspire you with some portion of that pleasure, which I have described as enjoyed by the astronomer himself.

As, in the course of these Letters, I propose to trace an outline of the history of astronomy, from the earliest ages to the present time, you may think this the most suitable place for introducing it; but the successive discoveries in the science cannot be fully understood and appreciated, until after an acquaintance has been formed with the science itself. We must therefore reserve the details of this subject for a future opportunity; but it may be stated here that astronomy was cultivated the earliest of all the sciences; that great attention was paid to it by several very ancient nations, as the Egyptians and Chaldeans, and the people of India and China, before it took its rise in Greece. More than six hundred years before the Christian era, however, it began to be studied in this latter country. Thales and Pythagoras were particularly distinguished for their devotion to this science; and the celebrated school of Alexandria, in Egypt, which took its rise about three hundred years before the Christian era, and flourished for several hundred years, numbered among its disciples a succession of eminent astronomers, among whom were Hipparchus, Eratosthenes, and Ptolemy. The last of these composed a great work on astronomy, called the "Almagest," in which is transmitted to us an account of all that was known of the science by the Alexandrian school. The "Almagest" was the principal text-book in astronomy for many centuries afterwards; and comparatively few improvements were made until the age of Copernicus. Copernicus was born at Thorn, in Prussia, in

1473. Previous to his time, the doctrine was held that the earth is at rest in the centre of the universe, and that the sun, moon, and stars, revolve about it every day, from east to west; in short, that the *apparent* motions of the heavenly bodies are the same with their *real* motions. But Copernicus expounded what is now known to be the true theory of the celestial motions, in which the sun is placed in the centre of the solar system, and the earth and all the planets are made to revolve around him, from west to east; while the apparent diurnal motion of the heavenly bodies from east to west, is explained by the revolution of the earth on its axis, in the same time from west to east,—a motion of which we are unconscious, and which we erroneously ascribe to external objects, as we imagine the shore is receding from us, when we are unconscious of the motion of the ship that carries us from it.

Although many of the appearances, presented by the motions of the heavenly bodies, may be explained on the former erroneous hypothesis, yet, like other hypotheses founded in error, it was continually leading its votaries into difficulties, and blinding their minds to the perception of truth. They had advanced nearly as far as it was practicable to go in the wrong road; and the great and sublime discoveries of modern times are owing, in no small degree, to the fact, that, since the days of Copernicus, astronomers have been pursuing the plain and simple path of truth, instead of threading their way through the mazes of error.

Near the close of the sixteenth century, Tycho Brahe, a native of Sweden, but a resident of Denmark, carried astronomical observations (which constitute the basis of all that is valuable in astronomy) to a far greater degree of perfection than had ever been done before. Kepler, a native of Germany, one of the greatest geniuses the world has ever seen, was contemporary with Tycho Brahe, and was associated with him in a part of his labours. Galileo, an Italian astronomer of great eminence, flourished only a little later than Tycho Brahe. He invented the telescope, and, both by his discoveries and reasonings, contributed greatly to establish the true system of the world. Soon after the commencement of the seventeenth century (1620), Lord Bacon, a celebrated English philosopher, pointed out the true method of conducting all inquiries into the phenomena of Nature, and introduced the *inductive method of philosophizing*. According to the inductive method, we are to begin our inquiries into the causes of any events by first examining and classifying all the *facts* that relate to it, and, from the comparison of these, to deduce our conclusions.

But the greatest single discovery, that has ever been made in astronomy, was the law of universal gravitation—a discovery made by Sir Isaac Newton, in the latter part of the seventeenth century. The discovery of this law made us acquainted with the hidden forces that move the great machinery of the universe. It furnished the key which unlocks the inner temple of Nature; and from this time we may regard astronomy as fixed on a sure and immovable basis. I shall hereafter endeavour to explain to you the leading principles of universal gravitation, when we come to the proper place for inquiring into the causes of the celestial motions, as exemplified in the motion of the earth around the sun.

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## LETTER II.

### DOCTRINE OF THE SPHERE.

“All are but parts of one stupendous whole,  
Whose body Nature is, and God the soul!”—*Pope*.

LET us now consider what astronomy is, and into what great divisions it is distributed; and then we will take a cursory view of the doctrine of the sphere. This subject will probably be less interesting to you than many that are to follow; but still, permit me to urge upon you the necessity of studying it with attention, and reflecting upon each definition, until you fully understand it; for, unless you fully and clearly comprehend the circles of the sphere, and the use that is made of them in astronomy,



a mist will hang over every subsequent portion of the science. I beg you, therefore, to pause upon every paragraph of this Letter; and if there is any point in the whole which you cannot clearly understand, I would advise you to mark it, and to recur to it repeatedly; and, if you finally cannot obtain a clear idea of it yourself, I would recommend to you to apply for aid to some of your friends, who may be able to assist you.

*Astronomy is that science which treats of the heavenly bodies.* More particularly, its object is to teach what is known respecting the sun, moon, planets, comets, and fixed stars; and also to explain the methods by which this knowledge is acquired. Astronomy is sometimes divided into descriptive, physical, and practical. Descriptive astronomy respects *facts*; physical astronomy, *causes*; practical astronomy, the *means of investigating the facts*, whether by instruments or by calculation. It is the province of descriptive astronomy to observe, classify, and record, all the phenomena of the heavenly bodies, whether pertaining to those bodies individually, or resulting from their motions and mutual relations. It is the part of physical astronomy to explain the causes of these phenomena, by investigating the general laws on which they depend; especially, by tracing out all the consequences of the law of universal gravitation. Practical astronomy lends its aid to both the other departments.

The definitions of the different lines, points, and circles, which are used in astronomy, and the propositions founded upon them, compose the *doctrine of the sphere*. Before these definitions are given, I must recall to your recollection a few particulars respecting the method of measuring angles. (See Fig. 1.)

A line drawn from the centre to the circumference of a circle is called a *radius*, as C D, C B, or C K.

Any part of the circumference of a circle is called an *arc*, as A B, or B D.

An angle is measured by an arc included between two radii. Thus, in Fig. 1, the angle contained between the two radii, C A and C B, that is, the angle A C B, is measured by the arc A B. Every circle, it will be recollected, is divided into three hundred and sixty equal parts, called degrees; and any arc, as A B, contains a certain number of degrees, according to its length. Thus, if the arc A B contains forty degrees, then the opposite angle A C B is said to be an angle of forty degrees, and

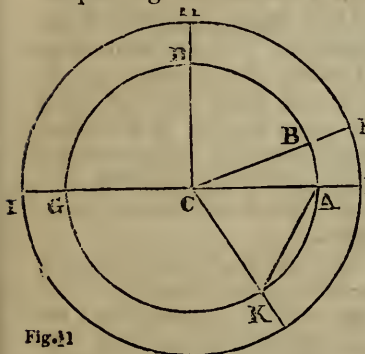


Fig. 1

to be measured by A. B. But this arc is the same part of the smaller circle that E F is of the greater. The arc A B, therefore, contains the same number of degrees as the arc E F, and either may be taken as the measure of the angle A C B. As the whole circle contains three hundred and sixty degrees, it is evident, that the quarter of a circle, or *quadrant*, contains ninety degrees, and that the semicircle A B D G contains one hundred and eighty degrees.

The *complement* of an arc, or angle, is what it wants of ninety degrees. Thus, since A D is an arc of ninety degrees, B D is the complement of A B, and A B is the complement of B D. If A B denote a certain number of degrees of latitude, B D will be the complement of the latitude, or the colatitude, as it is commonly written.

The *supplement* of an arc, or angle, is what it wants of one hundred and eighty degrees. Thus, B A is the supplement of G D B, and G D B is the supplement of B A. If B A were twenty degrees of longitude, G D B, its supplement, would be one hundred and sixty degrees. An angle is said to be *subtended* by the side which is opposite to it. Thus, in the triangle A C K, the angle at C is subtended by the side A K, the angle at A by C K, the angle at K by C A. In like manner, a side is said to be subtended by an angle, as A K by the angle at C.

Let us now proceed with the doctrine of the sphere.

A section of a sphere, by a plane cutting it in any manner, is a circle. *Great circles* are those which pass through the centre of the sphere, and divide it into two equal hemispheres. *Small circles* are such as do not pass through the centre, but



divide the sphere into two unequal parts. The *axis* of a circle is a straight line passing through its centre at right angles to its plane. The *pole* of a great circle is the point on the sphere where its axis cuts through the sphere. Every great circle has two poles, each of which is everywhere ninety degrees from the great circle. All great circles of the sphere cut each other in two points diametrically opposite, and consequently their points of section are one hundred and eighty degrees apart. A great circle, which passes through the pole of another great circle, cuts the latter at right angles. The great circle which passes through the pole of another great circle, and is at right angles to it, is called a *secondary* to that circle. The angle made by two great circles on the surface of the sphere is measured by an arc of another great circle, of which the angular point is the pole, being the arc of that great circle intercepted between those two circles.

In order to fix the position of any place, either on the surface of the earth or in the heavens, both the earth and the heavens are conceived to be divided into separate portions by circles, which are imagined to cut through them in various ways. The earth thus intersected is called the *terrestrial*, and the heavens the *celestial*, sphere. We must bear in mind, that these circles have no existence in Nature, but are mere landmarks, artificially contrived for convenience of reference. On account of the immense distances of the heavenly bodies, they appear to us, wherever we are placed, to be fixed in the same concave surface, or celestial vault. The great circles of the globe, extended every way to meet the concave sphere of the heavens, become circles of the celestial sphere.

The *horizon* is the great circle which divides the earth into upper and lower hemispheres, and separates the visible heavens from the invisible. This is the *rational* horizon. The *sensible* horizon is a circle touching the earth at the place of the spectator, and is bounded by the line in which the earth and skies seem to meet. The sensible horizon is parallel to the rational, but is distant from it by the semi-diameter of the earth, or nearly four thousand miles. Still, so vast is the distance of the starry sphere, that both these planes appear to cut the sphere in the same line; so that we see the same hemisphere of stars that we should see, if the upper half of the earth were removed, and we stood on the rational horizon.

The poles of the horizon are the zenith and nadir. The *zenith* is the point directly over our heads; and the *nadir*, that directly under our feet. The plumbline (such as is formed by suspending a bullet by a string) is in the axis of the horizon, and consequently directed towards its poles. Every place on the surface of the earth has its own horizon; and the traveller has a new horizon at every step, always extending ninety degrees from him, in all directions.

*Vertical circles* are those which pass through the poles of the horizon (the zenith and nadir), perpendicular to it.

The *meridian* is that vertical circle which passes through the north and south points.

The *prime vertical* is that vertical circle which passes through the east and west points.

The *altitude* of a body is its elevation above the horizon, measured on a vertical circle.

The *azimuth* of a body is its distance, measured on the horizon, from the meridian to a vertical circle passing through that body.

The *amplitude* of a body is its distance, on the horizon, from the prime vertical to a vertical circle passing through the body.

Azimuth is reckoned ninety degrees from either the north or south point; and amplitude ninety degrees from either the east or west point. Azimuth and amplitude are mutually complements of each other, for one makes up what the other wants of ninety degrees. When a point is *on* the horizon, it is only necessary to count the number of degrees of the horizon between that point and the meridian, in order to find its azimuth; but if the point is *above* the horizon, then its azimuth is estimated by passing a vertical circle through it, and reckoning the azimuth from the point where this circle cuts the horizon.

The *zenith distance* of a body is measured on a vertical circle passing through that body. It is the complement of the altitude.

The *axis of the earth* is the diameter on which the earth is conceived to turn in its diurnal revolution. The same line, continued until it meets the starry concave, constitutes the *axis of the celestial sphere*.

The *poles of the earth* are the extremities of the earth's axis: the *poles of the heavens*, the extremities of the celestial axis.

The *equator* is a great circle cutting the axis of the earth at right angles. Hence, the axis of the earth is the axis of the equator, and its poles are the poles of the equator. The intersection of the plane of the equator with the surface of the earth constitutes the *terrestrial*, and its intersection with the concave sphere of the heavens, the *celestial*, equator. The latter, by way of distinction, is sometimes denominated the *equinoctial*.

The secondaries to the equator,—that is, the great circles passing through the poles of the equator,—are called *meridians*, because that secondary which passes through the zenith of any place is the meridian of that place, and is at right angles both to the equator and the horizon, passing, as it does, through the poles of both. These secondaries are also called *hour circles*, because the arcs of the equator intercepted between them are used as measures of time.

The *latitude* of a place on the earth is its distance from the equator north or south. The *polar distance*, or angular distance from the nearest pole, is the complement of the latitude.

The *longitude* of a place is its distance from some standard meridian, either east or west, measured on the equator. The meridian, usually taken as the standard, is that of the Observatory of Greenwich. If a place is directly on the equator, we have only to inquire how many degrees of the equator there are between that place and the point where the meridian of Greenwich cuts the equator. If the place is north or south of the equator, then its longitude is the arc of the equator intercepted between the meridian which passes through the place and the meridian of Greenwich.

The *ecliptic* is a great circle, in which the earth performs its annual revolutions around the sun. It passes through the centre of the earth, and the centre of the sun. It is found, by observation, that the earth does not lie with its axis at right angles to the plane of the ecliptic, so as to make the equator coincide with it, but that it is turned about twenty-three and a half degrees out of a perpendicular direction, making an angle with the plane itself of sixty-six and a half degrees. The equator, therefore, must be turned the same distance out of a coincidence with the ecliptic, the two circles making an angle with each other of twenty-three and a half degrees. It is particularly important that we should form correct ideas of the ecliptic, and of its relations to the equator, since to these two circles a great number of astronomical measurements and phenomena are referred.

The *equinoctial points*, or *equinoxes*, are the intersections of the ecliptic and equator. The time when the sun crosses the equator, in going northward, is called the *vernal*, and in returning southward, the *autumnal* equinox. The vernal equinox occurs about the twenty-first of March, and the autumnal, about the twenty-second of September.

The *solstitial points* are the two points of the ecliptic most distant from the equator. The times when the sun comes to them are called *solstices*. The summer solstice occurs about the twenty-second of June, and the winter solstice about the twenty-second of December. The ecliptic is divided into twelve equal parts, of thirty degrees each, called *signs*, which, beginning at the vernal equinox, succeed each other in the following order:

1. Aries,	♈	7. Libra,	♎
2. Taurus,	♉	8. Scorpio	♏
3. Gemini,	♊	9. Sagittarius,	♐
4. Cancer,	♋	10. Capricornus	♑
5. Leo,	♌	11. Aquarius,	♒
6. Virgo,	♍	12. Pisces.	♓

The mode of reckoning on the ecliptic is by signs, degrees, minutes, and seconds.



The sign is denoted either by its name or its number. Thus, one hundred degrees may be expressed as the tenth degree of Cancer, or as  $3^{\circ} 10^{\circ}$ . It will be found an advantage to repeat the signs in their proper order, until they are well fixed in the memory, and to be able to recognise each sign by its appropriate character.

Of the various meridians, two are distinguished by the name of *colures*. The *equinoctial colure* is the meridian which passes through the equinoctial points. From this meridian, right ascension and celestial longitude are reckoned, as longitude on the earth is reckoned from the meridian of Greenwich. The *solstitial colure* is the meridian which passes through the solstitial points.

The position of a celestial body is referred to the equator by its right ascension and declination. *Right ascension* is the angular distance from the vernal equinox measured on the equator. If a star is situated on the equator, then its right ascension is the number of degrees of the equator between the star and the vernal equinox. But if the star is north or south of the equator, then its right ascension is the number of degrees of the equator, intercepted between the vernal equinox and that secondary to the equator which passes through the star. *Declination* is the distance of a body from the equator measured on a secondary to the latter. Therefore, right ascension and declination correspond to terrestrial longitude and latitude,—right ascension being reckoned from the equinoctial colure, in the same manner as longitude is reckoned from the meridian of Greenwich. On the other hand, celestial longitude and latitude are referred, not to the equator, but to the ecliptic. *Celestial longitude* is the distance of a body from the vernal equinox measured on the ecliptic. *Celestial latitude* is the distance from the ecliptic measured on a secondary to the latter. Or, more briefly, longitude is distance on the ecliptic; latitude, distance from the ecliptic. The *north polar distance* of a star is the complement of its declination.

*Parallels of latitude* are small circles parallel to the equator. They constantly diminish in size as we go from the equator to the pole. The *tropics* are the parallels of latitude which pass through the solstices. The northern tropic is called the tropic of Cancer; the southern, the tropic of Capricorn. The *polar circles* are the parallels of latitude that pass through the poles of the ecliptic, at the distance of twenty-three and a half degrees from the poles of the earth.

The *elevation of the pole* of the heavens above the horizon of any place is always equal to the latitude of the place. Thus, in forty degrees of north latitude we see the north star forty degrees above the northern horizon; whereas, if we should travel southward, its elevation would grow less and less, until we reached the equator, where it would appear in the horizon. Or, if we should travel northwards, the north star would rise continually higher and higher, until, if we could reach the pole of the earth, that star would appear directly over head. The *elevation of the equator* above the horizon of any place is equal to the complement of the latitude. Thus, at the latitude of forty degrees north, the equator is elevated fifty degrees above the southern horizon.

The earth is divided into five zones. That portion of the earth which lies between the tropics is called the *torrid zone*; that between the tropics and the polar circles, the *temperate zones*; and that between the polar circles and the poles, *frigid zones*.

The *zodiac* is the part of the celestial sphere which lies about eight degrees on each side of the ecliptic. This portion of the heavens is thus marked off by itself, because all the planets move within it.

After endeavouring to form, from the definitions, as clear an idea as we can of the various circles of the sphere, we may next resort to an artificial globe, and see how they are severally represented there. I do not advise to *begin* learning the definitions from the globe; the mind is more improved, and a power of conceiving clearly how things are in Nature is more effectually acquired by referring everything, at first, to the grand sphere of Nature itself, and afterwards resorting to artificial representations to aid our conceptions. We can get but a very imperfect idea of a man from a profile cut in paper, unless we know the original. If we are acquainted with the individual, the profile will assist us to recall his appearance more distinctly than we can do without it. In like manner, orreries, globes, and other artificial aids, will be found very useful, in assisting us to form distinct conceptions of the relations existing between the



different circles of the sphere, and of the arrangements of the heavenly bodies; but, unless we have already acquired some correct ideas of these things, by contemplating them as they are in Nature, artificial globes, and especially orreries, will be apt to mislead us.

I trust you will be able to obtain the use of a globe, to aid you in the study of the foregoing definitions, or doctrine of the sphere; but if not, I would recommend the following easy device. To represent the earth, select a large *apple* (a melon when in season, will be found still better). The eye and the stem of the apple will indicate the position of the two poles of earth. Applying the thumb and finger of the left hand to the poles, and holding the apple so that the poles may be in a north and south line, turn this globe from west to east, and its motion will correspond to the diurnal movement of the earth. Pass a wire, or a knitting-needle through the poles, and it will represent the *axis* of the sphere. A circle cut around the apple, half-way between the poles, will be the *equator*; and several other circles cut between the equator and the poles, parallel to the equator, will represent *parallels of latitude*; of which, two, drawn twenty-three and a half degrees from the equator, will be the *tropics*, and two others, at the same distance from the poles, will be the *polar circles*. A great circle cut through the poles, in a north and south direction, will form the *meridian*, and several other great circles drawn through the poles, and of course perpendicularly to the equator, will be secondaries to the equator, constituting meridians, or *hour circles*. A great circle cut through the centre of the earth, from one tropic to the other, would represent the *plane* of the ecliptic; and consequently a line cut round the apple where such a section meets the surface, will be the terrestrial *ecliptic*. The points where this circle meets the tropics indicate the position of the *solstices*; and its intersection with the equator, that of the *equinoctial points*.

The *horizon* is best represented by a circular piece of pasteboard, cut so as to fit closely to the apple, being movable upon it. When this horizon is passed through the poles, it becomes the horizon of the equator; when it is so placed as to coincide with the earth's equator, it becomes the horizon of the poles; and in every other situation it represents the horizon of a place on the globe ninety degrees every way from it. Suppose we are in latitude forty degrees; then let us place our movable paper parallel to our own horizon, and elevate the pole forty degrees above it, as near as we can judge by the eye. If we cut a circle around the apple, passing through its highest part, and through the east and west points, it will represent the *prime vertical*.

Simple as the foregoing device is, if you will take the trouble to construct one for yourself, it will lead you to more correct views of the doctrine of the sphere, than you would be apt to obtain from the most expensive artificial globes, although there are many other useful purposes which such globes serve, for which the apple would be inadequate. When you have thus made a sphere for yourself, or, with an artificial globe before you, if you have access to one, proceed to point out on it the various arcs of azimuth and altitude, right ascension and declination, terrestrial and celestial attitude and longitude,—these last being referred to the equator on the earth, and to the ecliptic in the heavens.

When the circles of the sphere are well learned, we may advantageously employ projections of them in various illustrations. By the *projection of the sphere* is meant a representation of all its parts on a plane. The plane itself is called the plane of projection. Let us take any circular ring, as a wire bent into a circle, and hold it in different positions before the eye. If we hold it parallel to the face, with the whole breadth opposite to the eye, we see it as an entire circle. If we turn it a little sideways, it appears oval, or as an ellipse; and, as we continue to turn it more and more round, the ellipse grows narrower and narrower, until, when the edge is presented to the eye, we see nothing but a line. Now imagine the ring to be near a perpendicular wall, and the eye to be removed at such a distance from it, as not to distinguish any interval between the ring and the wall; then the several figures under which the ring is seen will appear to be inscribed on the wall, and we shall see the ring as a circle, when perpendicular to a straight line joining the centre of the ring and the eye, or as an ellipse, when oblique to this line, or as a straight line, when its edge is towards us.

It is in this manner that the circles of the sphere are projected, as represented in the following diagram, Fig. 2. Here, various circles are represented as projected

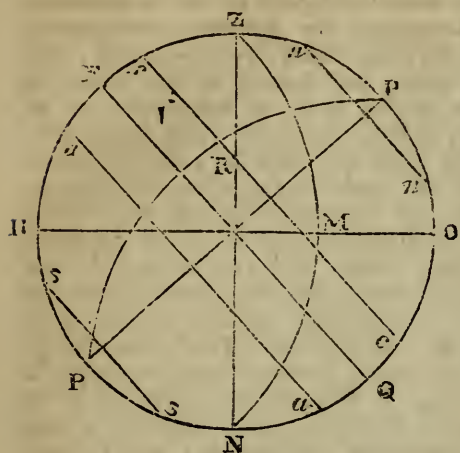


FIG. 2.

on the meridian, which is supposed to be situated directly before the eye, at some distance from it. The horizon H O, being perpendicular to the meridian, is seen edgewise, and consequently is projected into a straight line. The same is the case with the prime vertical Z N, with the equator E Q, and the several small circles parallel to the equator, which represent the two tropics and the two polar circles. In fact, all circles whatsoever, which are perpendicular to the plane of projection, will be represented by straight lines. But every circle which is perpendicular to the horizon, except the prime vertical, being seen obliquely, as Z M N, will be projected into an ellipse, one half only of which is seen, — the other half being on the other side of the plane of projection. In the same manner, P R P, an hour circle, is represented by an ellipse on the plane of projection.

(To be continued.)

MEDICINE was introduced in Greece 1530 years before the Christian era, by Melampus, an Argive; and Æsculapius, Hippocrates, and Galen, the most celebrated of all physicians, were natives of Greece. With respect to the ancient state of physic among the Egyptians, Clemens Alexandrinus informs us, that there were forty-two books of Hermes, of great account, which contained all the philosophy of the Egyptians, and the six last of which related to medicine, and treated of the construction of the body and its disorders, with the methods of treating them. Herodotus tells us that the practice of physic was so parcelled out and divided, that one physician had the charge only of one distemper, and might not presume to take upon him the care and inspection of more. It may here be remarked, as auxiliary of the means by which England originally obtained a firm footing in the Indian empire, that the science and humanity of an English physician, in effecting the cure of a daughter of the emperor, who was a descendant of Tamerlane, led to acts of the most unbounded and generous confidence in English skill and English integrity. The Chinese, indeed, promulgated a medicine to insure immortality. This grand secret was arrogated by a sect called Tautse, the disciples of Lau-kyun, who boasted they had discovered a liquor by means whereof man should never die. A great number of Mandarins studied this art, as well as the diabolical one of magic; and the emperor Tsin-she-whang-ti, a declared enemy to learning and to learned men, was persuaded by these impostors that they had actually such a liquid, and gave it the name of Chang-seng-you,—medicine of eternal life. Itinerant practitioners have, however, prevailed in all ages and all countries; and lamentable is the fact, that in this great metropolis, the numerous ignorant and impudent pretenders to the most difficult and important of all the branches of science, should not be dealt with as in the “olden time;” for though our ancestors were certainly not deficient in credulity, they did not think so lightly of empiricism as we do. In the reign of Edward VI., one Grigg was set in the pillory at Croydon, and again in the borough of Southwark, for pretending to cure the diseased by looking at their water. Under James I., who was a believer in the occult sciences, several quacks, and some who assumed the solemn title of doctor in medicine, were brought to public justice, and compelled to find security for their future good behaviour. Even so late as the time of King William, one Fairfax was fined and imprisoned for vending a specific which he called *aqua celestis*, and others of a like description have, at various times, suffered heavily for administering dangerous drugs to the people.



## ON THE ENGLISH LANGUAGE.

Our language, like our island, has undergone many revolutions, and perhaps each for the best. It derives its origin from various sources; it has been propagated by many different nations; and owes some of its excellencies to them all. Its basis may be said to be Saxon, with such an intermixture of ancient and modern words as conquest, commerce, or learning, in a succession of ages, has gradually introduced.

From the influx of so many streams, from the connection of so many dissimilar parts, it naturally follows, that the English, like every compounded language, must possess a certain degree of irregularity. That complete analogy in structure cannot therefore be expected from it, which is found in those simpler languages, which have been derived from one source, and raised on one foundation. Hence, our syntax is confined; since there are few marks in the words themselves, which can show their relation to each other, or point out, either their concordance, or their government, in the sentence. But if these disadvantages attend a compounded language, they are balanced by other attendant beauties; particularly by the number and variety of words, with which such a language is commonly enriched. And, in fact, few languages are more copious than the English. In all the graver subjects of human investigation or discussion, no complaints can justly be made of the sterility of our tongue. We are likewise rich in the language of poetry: our poetical style differs essentially from prose; not with respect to numbers only, but in the very words themselves. In this, we have an infinite superiority over the French, whose poetical language, were it not distinguished by rhyme, would not appear to differ very considerably from their prose. Their language, however, surpasses ours in expressing whatever is gay, delicate, and amusing: for conversation it is unrivalled; but for the higher subjects of composition, it is justly considered as inferior to the English.

The flexibility of a language, or its power of adaptation to grave and strong, easy and flowing, tender and gentle, pompous and magnificent sentiments, as occa-

sions require, is a quality of great consideration, both in speaking and writing. This seems to depend on the copiousness of language; the different arrangement of which its words are susceptible; and the variety and beauty of the sound of those words, so as to correspond to so many different subjects. The Greek possesses these requisites in a higher degree than any other language, ancient or modern. It superadds the graceful variety of its different dialects to its beautiful original form; and thereby readily assumes every kind of character, from the most simple and familiar, to the most formal and majestic. The Latin, though it has many intrinsic and appropriate beauties, in this respect is inferior to the Greek. It has more of a settled character of stateliness and gravity; and is supported by a certain senatorial dignity, of which it is not easy to be uniformly divested. Among the modern tongues, the Italian, as possessing on the whole the greatest degree of flexibility, seems to be the most perfect of all the modern dialects, which have arisen from the ruins of the ancient.

Our language, though it cannot pretend to equal the Italian in flexibility, has, nevertheless, a very considerable portion of this valuable quality. Whoever considers the diversity of style which appears in some of our most distinguished writers, will discover such a circle of expression, and such a power of accommodation to the various tastes of men, as must redound to the honour of our tongue, and deservedly fix its reputation.

Harmony of sound has ever been regarded as essential to perfect language; and in this quality, English has been supposed to be very deficient: yet whoever considers the melody of its versification, and its power of supporting poetical numbers without the assistance of rhyme, must confess, that it is far from being unharmonious. Even our prose, in the hands of a writer of taste, is susceptible of musical periods; and our poetry has received a smoothness and polish from Pope and some others, that can scarcely be surpassed in any language. Smoothness, however, it must be admitted is not the distinguishing characteristic of the English tongue. Strength and expression, rather than grace



and melody, constitute its character. The simplicity of its form and construction is certainly superior to that of any of the European dialects; a property deserving attention. It is free from the intricacy of cases, declensions, moods, and tenses. Its words are subject to fewer variations from their original form, than those of any other language. Its substantives have no other distinction of gender, but what is made by nature; and but one variation in case, namely, the possessive. Its adjectives admit of no change, except what expresses the degree of comparison. Its verbs, instead of the inflections of other languages, admit no more than four or five changes in termination. A few prepositions and auxiliary verbs supply all the purposes of tenses; whilst the words in general preserve their form unaltered. Hence our language possesses a simplicity and facility, which is the very reason why it is so frequently spoken and written with inaccuracy. We imagine that a competent skill in it may be acquired without any study; and that in a syntax so narrow and limited as ours, there is nothing which requires attention. But the fundamental rules of syntax are common to the English, as well as to the ancient tongues; and a regard to them is absolutely necessary, if we wish to write with propriety, purity, or elegance.

In short, whatever may be the comparative advantages or defects of our language, it certainly deserves in the highest degree, our study and attention. The Greeks and Romans, in the meridian of their glory, thought the cultivation of their respective languages, an object worthy their most serious regard, their most sedulous application. The French and Italians have employed considerable industry upon theirs; and in this respect, their example is highly laudable, and deserving imitation. For whatever knowledge may be gained by the study of other languages, it can never be communicated with advantage, unless by those who can write and speak their own language with promptitude and purity. Without this, the matter of an author, be it ever so good and useful, will suffer in the public esteem. The marble block will be passed without notice; it is the polish of the statuary that arrests the attention

## EASTERN RAMBLES AND REMINISCENCES.

### RAMBLE THE TWENTY-FIRST.

EASTERN TWILIGHT — NIGHT ON THE  
NILE — THE TORMENTING MOSQUITOES  
—HOW TO GET RID OF MOSQUITOES—A  
VALUABLE RECIPE—OUR COOKING AP-  
PARATUS—PROVISIONS ON THE NILE—  
ARRIVAL AT BOOLAK—GHIZEH TO THE  
PYRAMIDS—CAUSEWAY OF KARA-KOOST  
—CHEOPS, OR THE GREAT PYRAMID—  
ASCENT OF CHEOPS—VIEW FROM ITS  
SUMMIT.

\* \* \* "When first  
The eternal Pyramids of Memphis burst  
Awfully on my sight—standing sublime,  
'Twixt earth and heaven the watch-towers of  
Time,  
From whose lone summit, when his reign hath  
past  
From earth for ever, he will look his last!

\* \* \*  
There hung a calm and solemn sunshine round  
Those mighty monuments, a hushing sound  
In the still air that circled them, which stole  
Like music of past times into my soul."

MOORE.

"Here Fancy bows to Truth; Eldest of Time,  
Child of the world's fresh morning, Egypt saw  
These Pyramids rise gradually sublime,  
And æras pass, whose records, as with awe,  
Nature has will'd from history to withdraw:  
Yet learn, that on these stones has Abraham  
gazed,  
These regions round acknowledged Joseph's  
law,—  
That Obelisk from granite bed was raised  
Ere Moses in its shade sat and Jehovah  
praised."

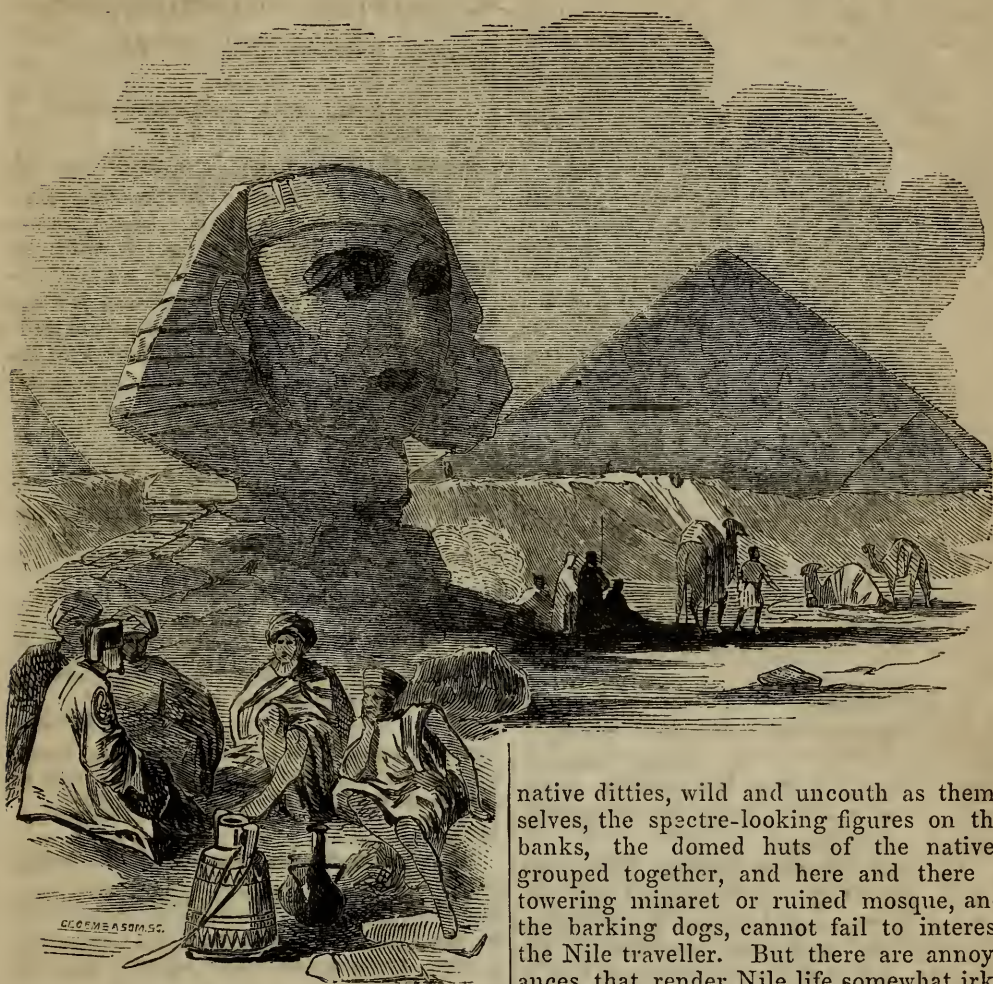
MONKTON MILNES.

"While to the west—where gradual sinks  
In the red sands, from Lybia roll'd,  
Some mighty column, or fair sphinx,  
That stood in kingly courts of old."

MOORE.

THAT beautiful period of the day in the East that succeeds sunset is the time for reverie and enjoyment; when the dewy tints of twilight take the place of the roseate hues of the glorious orb, or the orange flush that he sometimes leaves behind to mellow into the grey of evening. Then, reclining upon the soft mossy bank or flowery sod, wrapt in the coarse woollen cloak of the country, we can enjoy the beauties of nature, and indulge in pleasing reveries. O'er our head the feathery palm





waves its graceful branches, and the breezes, laden with the fragrance of shrubs, sigh among the foliage, and

“Blossoms, that like Jove’s golden showers,  
Seem rain’d o’er earth’s bosom there.”

Night, the period of general repose in European countries, is the time for enjoyment in the East. The peaceful quiet of the midnight hour, when no clouds obscure the chastened light of the moon, and the Kanghia glides through the Nile’s dark waters, the absence of heat, the flickering shadows thrown by stately palm trees upon the bosom of the eternal river as it sweeps onward, belting its dark banks as it were with liquid silver, the songs of Arabs who beguile the time they are rowing with

native ditties, wild and uncouth as themselves, the spectre-looking figures on the banks, the domed huts of the natives grouped together, and here and there a towering minaret or ruined mosque, and the barking dogs, cannot fail to interest the Nile traveller. But there are annoyances that render Nile life somewhat irksome, such as swarms of fleas, mosquitoes, rats, mice, cockroaches, spiders, and B flats, that hold their midnight revels and feast upon wearied travellers and their good cheer.

When morning dawns, if your tormentors have been less troublesome than usual, you rise to partake of a cup of coffee which the reis or captain of the boat has prepared for you, and then undressing, plunge overboard in the Nile. This is real luxury, such as can only be appreciated by those who have enjoyed it, after a restless night spent in battling with that worrying little mosquito that will pitch upon your cheek just as you are going off to sleep, and thereby cause you to give yourself a hearty slap in the face with



intent to kill him, when, lo! just as you have dozed off again, back he comes, and cries "cousin" in your ear. Up you start, and chase him all about the place with your handkerchief, and having deceived yourself that his end is peace, quietly compose yourself for another nap, when the pest comes back again, drops upon your nose, and begs to acquaint you, by a vigorous sting, that his end is not peace. In despair, perhaps, you rush out of the cabin and console yourself with a pipe. Why did you not think of that before? If you had, I will warrant that your *cousin* would not have bothered you, for depend upon it that tobacco is better than a *cousiniere*. Perhaps you do not smoke; then what is to be done? Well, I will tell you what I should do if placed in the same position again, but I did not know how to act then. I would follow the advice of Mr. Fortune, who was tormented by them in China, and suspend a couple of prepared bamboos from the roof of the boat, or any other place where these pests were.

In mentioning the method of getting rid of these tormentors, Mr. Fortune says: "Various substances are employed by the Chinese to drive away mosquitoes. This which we had just purchased was made with the sawings of resinous wood—I believe procured from juniper trees—and mixed with some combustible matter to make it burn. A piece of split bamboo, three or four feet in length, is then covered all over with this substance. When finished, it is as thick as a rattan or small cane. The upper end of the bamboo has a slit in it for hooking on to any nail in the wall, or to the roof of a boat. When once lighted, it goes on burning upwards until within six inches of the hook, beyond which there is no combustible matter, and it then dies out. A somewhat fragrant smell is given out during combustion, which, at a distance, is not disagreeable. Sometimes the sawdust is put up in coils of paper, and is then burned on the floors of the houses. Various species of wormwood are likewise employed for the same purpose. The stems and leaves of these plants are twisted and dried, and probably dipped in some preparation to make them burn." He adds, that when burning these sticks, he has never been troubled with mos-

quitoes, and that he has frequently cleared a boat or an inn of them by this means, although swarming when he entered. As some of my readers may be placed in a position to be troubled by these pests, I have been induced to digress, for the purpose of making his method known; I do not vouch for its efficacy, but it is worth trying.

Our party cast lots for the office of cook, but as it fell to the lot of one who did not like soiling his fingers, I offered for the place, and was accepted, with the understanding that there should not be any grumbling if I made any vile compounds by mistake. It is not my intention to detail what we had for dinner, supper, or any other meal, nor how I cooked the victuals, but merely to mention that our cooking apparatus consisted of a few stones built up in the fore part of the vessel, and some sticks as spits, with a frying-pan, a gridiron, two Arab earthenware pots, and a tin pint pot for making our coffee in. With this apparatus I managed to cook them soup, fish, hashes, and stews; to roast and boil birds, &c., to make omelettes, fritters, and custards, and this was our general bill of fare every day, with fruit of some description, for which the sum total paid was about sixpence each.

Some of our party employed the early part of the morning fishing or shooting, and then bringing the fruits of their sport to me, I commenced getting the next meal ready. Others went on shore, when we stopped at some of the Arab villages and purchased provisions. The provisions supplied us by these Nile villages generally consisted of mutton or lamb, milk, butter of the country, fowls, eggs, and pancake-looking bread, all of which are remarkably good and cheap.

When dinner was finished we made sail, and passing a few country boats now and then, brought too about tea time at some village, and driving a stake in the banks fastened our boat to it; we then foraged the village for supplies for supper, and rambled about the lanes between the huts in search of tobacco or pipe-bowls, the latter being smashed at a great rate every day, either by some treading upon them, or else by falling off the lockers in the cabin, when a puff of wind made us lean over.



When supper was finished, we sent out the remnants of the day's victuals to our crew, who were as fine a set of dirty Arabs as one could meet with from Alexandria to the first cataract. It was a fine sight to see them feasting away upon the various kinds of food we had left, tasting this and smelling that, then laughing and looking at us: they seemed a merry lot of fellows, and did their work right well. Sometimes they would go aloft—no great height certainly—and shift the heavy sails from one side of the mast to the other; another time off would go their blue cotton dresses, like large smock frocks, and away they all go overboard to push our craft off a shoal, or tow her along the bank when there was not wind enough to sail. Their usual fare seemed to consist of boiled lentils and brown bread mashed up together in a bowl, which was placed on the deck in the centre of them, and each then dipped his hand in the dish,\* and took up a portion of the mess with his fingers.

Just an hour after sunset we arrived at Boolak, which is only about a mile from Cairo. It contains about 20,000 inhabitants, who manufacture cotton and linen cloths, and striped silks like those of Syria. Its houses are inferior to those of Cairo, and its streets narrow and dirty. It has a handsome mosque, and a printing-office belonging to the Viceroy.

As we wished to lose no time in visiting the Pyramids, we rose early the following morning, and mounting donkeys proceeded at once to the Hotel D'Orient, at Cairo, kept by Colombe and Co. Here we deposited our heavy luggage and all that was worth anything, and having engaged our various rooms, returned to the boat and sailed for Ghizeh, to visit the chicken-ovens and pyramids.

The sail from Boolak is beautiful, the banks of the river being overhung in many parts by graceful palm-trees, flowering acacias, and other shrubs, and the whole scene a busy one. In a short time we arrived at Ghizeh, and had the same scene enacted as at Alexandria with the donkeys; at last we were suited, and away we went in gallant style for the Pyramids.

Leaving Ghizeh, we rode over several fields for about two miles, and then the character of the soil changed, pebbles, sand, and parched weeds taking the place of luxuriant corn and clover; and then the Pyramids themselves appeared close at hand just as we turned a corner of the road, yet they were at least four miles distant. An hour's ride brought us to the old ruined causeway of Kara-Koosh, a respectable old man, who took a fancy into his head that the Pyramids were not of much use, and that the stones were, and he therefore built this causeway to transport the stones of the Pyramids to Cairo, to build the citadel. Leaving this, we journeyed on for about a mile, and then reached the table-land of stone on which the Pyramids stand; it is about 150 feet above the surrounding level, from which the sides of the Pyramids arise; therefore they look much higher as they are approached than they really are.

When about a mile from these wonders of art, I turned to one of my companions, and said with some degree of disappointment, "Why, they look more like a heap of mud-bricks than anything else," such, in fact, being their general appearance at a distance; but as we approached nearer, I was lost in astonishment at their magnitude and peculiar arrangement and appearance. But when I had dismounted and stood at their base, looking up their sloping sides to the summit, where a small speck moved about like a lady-bird on a flower-pot, I was completely carried away with enthusiasm and wonder.

Time, and the depredations of Kara-Koosh, have removed some of the stones that were originally built in to form the facing of the great Pyramid, and a series of steps now remain, which rises from the base to the apex, varying in height from two to four feet, and being about 210 in number, and the summit of the Pyramid is a platform thirteen feet square.

With respect to the origin of these lofty monuments of antiquity, many conjectures have been formed: some imagined that the Israelites built them while in a state of bondage; that is to say, because they could not help it; but it is not a satisfactory theory, and therefore we shall not entertain that or any other wild speculation.

\* This is an old custom in the East. See Mark xiv. 20.

It is generally admitted that the Great Pyramid was erected by Cheops (the Chemmis of Diodorus Siculus; Suphis of Manetho, and Shofa of Col. Vyse). Now Cheops was anything but a well-behaved Pharaoh, for he abandoned himself to every kind of depravity, he closed all the temples, forbade the Egyptians to offer sacrifices, and ordered their labours to be confined to his own purposes. Having projected the building of a pyramid, he compelled some to hew stones in the quarries of the Arabian mountains, and to drag them to the banks of the Nile; others were appointed to receive them from the boats, and transport them to the mountain of Lybia; and for this service, 100,000 men were employed who were relieved every three months. In the operation of forming the road, by which the stones were carried, ten years were consumed: and this arduous undertaking was followed by erecting the pyramid itself, which, independent of the time employed in preparing the platform on which it stands, occupied twenty years.

The Great Pyramid,—that is, the Pyramid of the hard-hearted Cheops,—is 733 feet square at the base, and 481 in perpendicular height, but taken on the slant, it is 733 feet, the same as the extent of the whole base, so that it forms an equilateral triangle; the whole area of the base is therefore 480,249 square feet, or rather more than 11 English acres. It contains 32,028,000 cubic feet of masonry, which would weigh about 6,848,000 tons, and the whole is built of blocks of limestone, each varying from 2 to 5 feet square; and arranged in layers, so regularly, that a line drawn from the top to the bottom, would touch the edge or angle of every step. The number of steps, or layers, is variously estimated by different authors. Greaves estimates them at 207; Maillet 208; Pococke 202; Belon 250; Thevenot 208; and your humble servant 203.

The lower courses are higher than the rest; and the lowest is hewn out of the solid rock, and so is part of the second.

The day was oppressively hot, and the Arabs disgustingly troublesome, for they would not allow me even to wipe the perspiration from my forehead, without three of them rushing at me apparently for the purpose of assisting me; but in



reality only for a *baksheesh*, and to put me in a more violent perspiration, with the exertion of driving them away, which of course caused me to commence mopping again, and they to begin rushing at me. At last, to settle this state of affairs, I thrashed several with my cowhide, and selected three to assist me in ascending the great pyramid, which we had been informed, was a most dangerous and difficult task.

Would that I had never seen the abominable Arabs, or that I had thrashed them away with the others, for no sooner were they selected, than to show their zeal in my service, two of them seized my arms, while the third pushed me behind, and away they tore to the sound of the universal "*Yallah*," "*Rouhh*," "*Jurchi*."

The spirit of Cheops seemed to animate them as they pushed, dragged, and tumbled me over the large stones, of which the pyramid is formed, and right glad was I when we reached the top, and could rest upon the platform there. Thirteen minutes was the time occupied in bundling me up the side of the mighty Cheops,



which may be climbed without any danger or difficulty, in about twenty minutes, or half an hour. One fact I must not forget to mention, to show the absurdity of the danger that is said to attend an ascent of this wonder of art; an Arab girl ran before us the whole way, without even looking where she was going, and at the same time carrying one of the porous jars of the country full of water, which she offered to me as soon as we had gained the summit. The rest of our party arrived a few minutes after myself, with the exception of one, who certainly never could have been entered at any race as a light weight; and he kicked and swore at every three or four steps, because the Arabs would not stop to allow him to puff and wipe his forehead. Poor man, he considers himself, even now, a perfect martyr to the laws of *baksheesh* and Arab civility, and never omits to exclaim against the ascent of the pyramids, and all such places being useless and unprofitable, concluding all arguments brought forward to the contrary, with "Cui bono?"

It is scarcely possible to express the feelings one experiences when gazing from this wonder towards our left, on the desert where

"Death rides upon the sulphury siroc,"

and slays thousands of pilgrims, whose bones are now bleaching on its burning sands; on the Nile, that blessing to the people of Egypt rendered memorable by Sacred History; upon the dark and distant mountains of Mokattam; upon Heliopolis; upon the lofty and glittering minarets of Cairo, with its mosques and domes, amid luxuriant trees; upon the second pyramid, the sphinx, the tombs, and the undulating sandy hills of the Arabian desert; and the long range of pyramids extending along the edge of the desert to the ruined Memphis. They rival in intensity those excited by the view from the tower of St. Mark, at Venice, or from the ruins of the Acropolis; such a moment may well be said to be an epoch in one's life, never to be forgotten, and only to be surpassed when we have led a truant life, for years wandering o'er

foreign lands, and on returning, see the white cliffs of Albion, our Mother Isle, with her patriot sons and beauteous daughters. *That* is a feeling that every Briton *must* experience:

"Yes, I have felt a proud emotion swell,  
That I was British-born; that I had lived  
A witness of thy glory, my most loved  
And honour'd country."

#### INTERESTING ECHOES.

In the Cathedral of Cirkenti, in Sicily, the slightest whisper is borne with perfect distinctness from the great western door to the high altar, a distance of 250 feet. By a most unlucky coincidence, the precise focus of divergence at the former station was chosen for the place of the confessional. Secrets never intended for the public ear thus became known to the dismay of the confessor and the scandal of the people, by the resort of the curious to the opposite point (which seems to have been discovered accidentally), till at length, one listener having had his curiosity somewhat over gratified, by hearing his wife's avowal of her own infidelity, this tell-tale peculiarity became generally known, and the confessional was removed.

Beneath the suspension-bridge across the Menai Strait in Wales, close to one of the main piers, is a remarkably fine echo. The sound of a blow on the pier with a hammer is returned in succession from each of the cross-beams which support the roadway, and from the opposite pier at a distance of 576 feet, and in addition to this, the sound is many times repeated between the water and the roadway. The effect is a series of sounds, which may be thus described:—The first return, is sharp and strong from the roadway overhead, the rattling which succeeds dies rapidly away, but the single repercussion from the opposite pier is very strong and is succeeded by a faint palpitation, repeating the sound at the rate of twenty-eight times in five seconds, and which, therefore, corresponds to a distance of 180 feet, or very nearly the double interval from the roadway to the water. Thus it appears, that in the repercussion between the water and the roadway, that from the latter only affects the ear, the line drawn from the auditor to the water being too oblique for the sound to diverge sufficiently in that direction. Another peculiarity deserves especial notice, namely, that the echo from the opposite pier is best heard when the auditor stands precisely opposite to the middle of the breadth of the pier, and strikes just on that point. As it deviates to one or the other side, the return is proportionably fainter, and is scarcely heard by him when his station is a little beyond the extreme edge of the pier, though another person stationed (on the same side of the water) at an equal distance from the central point, so as to have the pier between them, hears it well.

## THE MIRROR OF NATURE.

(Continued from page 332.)

THE language of words is a common piece of mechanism, in constructing which all human beings are engaged, impelled by an instinct similar to that, which, as a mechanical impulse, moves bees to the common structure of the honeycomb. The soul, thinking in words, feels itself thus prompted to communicate its own inward emotions to other souls through speech, and to receive from them similar communications. The dumb and blind Laura was just as *talkative* as other lively children of her age and sex. Whenever by chance, in company with one of the inmates of the Institution, or even with such friends of the house as understood the finger-alphabet, she found time and opportunity, she instantly engaged in conversation; with children of equal practice with herself, her fingers moved so fast that the spectator could scarcely follow their motions. The subjects of conversation were commonly the same as among other well-disposed, intelligent children, yet Laura expressed on every occasion a singular desire to know and to inquire.

When her teacher was engaged in instructing her, when she began to read the books for the blind, printed in raised letters, this eagerness of a spirit, struggling for knowledge, expressed itself continually in relation to what she had read. When in this way she wished to learn something about worms, she asked her teacher: "Does your mother keep worms?" (No—worms do not live in houses.)—"Why?" (Because they find things to eat out of the house.)—"And to play?"—"Have you seen a worm?" "Had he eyes, had he ears, had he thoughts?"—"Breathes he?"—"Strong?"—"When he is tired?"—"Does worm know you?"—"Is he frightened when hen eats him?"

Another time she asked: "Can cow-horse push with horns?"—"Do horse and cow sleep in barn?"—"Does horse sit at night?"—"Why have cows horns?"—(To push bad cows when they are disturbed by them.)—"Do bad cows understand to go away when good cow pushes them?"—"Why have cows two horns? to push two cows?"

When, in her little reading-exercises,

Laura found words that she did not understand, she ceased not to ask and inquire, and when her teacher found herself incapable of making the meaning of a word intelligible, then the ardour of her desire to know assumed the form of impatience. "I will ask the doctor," said she "for I must know it."

The natural desire for communication, which belongs to our nature, showed itself in Laura, particularly in the pains she took to assist other children who were deaf and blind like her, and who were brought to the Institution, in understanding and using the language of words. Here she showed herself so ingenious and so active that the teachers found her aid really valuable. The little deaf and blind Oliver Caswell, by no means without talent, and the older but much less gifted Lucy Reed, caught, through a happy device of Laura's, the first light in regard to the relation in which written words stand to the objects which they represent. To assist the former, whose senses of smell and taste were unimpaired, in understanding the word *bread*, she put a piece of bread to his mouth and nose, and she did the same with a fig in the case of Lucy.

In the same measure in which the soul uses its powers to acquire knowledge of external things, it learns to perceive those powers (as already mentioned) in itself, and so arrives at a consciousness of itself. Little children, when they begin to talk, as well as persons of defective intellect, always speak of themselves as of strangers, in the third person. This Laura did when she first began to use words, and when she was hungry or thirsty, she said, "Give Laura bread," or "Laura drink water." As soon, however, as she had become more practised in words, and the circle of her knowledge of the outer world extended into the world within, her more perfect self-consciousness showed itself, in that she now said, *I* will or *I* must go here or there, or write this or that letter. When the wisely discerning spirit of man thus takes possession of itself, it immediately attains to a power over the external behaviour and the whole conduct, by which this receives the impress of a moral order. The maidenly grace, the fine sense of the proper or the improper, the right or the wrong, came to Laura not through imitation



of other rational acting human beings, not by instruction from without, but from her own nature, from the innate feeling of the mind, thus perceiving and exercising its will, rationally. How deeply was the lively child grieved, how did her regret speak from every feature of her countenance when she found that one of her playmates had been hurt by her! The maidenly modesty of the little dumb and blind girl went so far that she would never undress her doll, when she wished to put it to bed, in the presence of Dr. Howe, but always waited until she was alone with her female teacher. While she gratefully reciprocated every token of sympathy shown her by persons of her own sex, she demeaned herself with a careful reserve towards the other sex, declining even to give her hand by way of greeting. As has been observed in other persons afflicted like her, she had a conscientious regard for property. At table she conducted herself with great propriety and moderation. With a perception of the becoming, she had also sense of the beautiful and pleasing which is characteristic of her sex. Even in the arrangement of her hair and in her dress there was a manifest aim to study ornament; and in new dresses and in every little trifle which belongs to the decoration of the female form, she testified great pleasure, and could not conceal the wish to show herself to others who could see.

From this and similar instances of blind mutes who have shown themselves in their external destitution, as cheerful and happy and intelligent as persons possessed of perfect senses, we learn that the spiritual wealth of human nature cannot be annihilated even though all those noble treasures are lost which are furnished through the bodily senses. Under these infirmities, man may be compared to an opulent individual, whose wealth is not entrusted to a single ship, far off upon the sea, nor does it consist in splendid edifices which the lightning may strike or a conflagration reduce to ashes, but whose riches are all found in a single costly diamond, which he always carries with him, and who, therefore, always escapes from the wrecked vessel or the burning house, a rich man. Without the senses of sight, of hearing, of smell and of taste, he is destitute of a world of external perceptions and enjoy-

ments, but he keeps the deed of possession, the patent right to the outer world in his interior being, and of course holds possession of the same, for there dwells in him a creative power which builds up within, what he gathers from without. The instinct of the animal turns to something near or distant, something present or future in the visible world, but the indwelling force, which moves man's nature, is directed not to a visible but to an invisible, spiritual world. What the mechanical instinct of the animal weaves or builds is, however beautiful it may be, nevertheless easily destructible, like the animal which has produced it; but that which the inner force of man builds and creates, is like the spirit itself, in and out of which it is generated, of an indestructible, eternal nature, and cannot disappear with the senses or the limbs, or waste away in the grave. For as the quail, when it journeys over the sea, rests indeed upon many an island, but nowhere tarries long until it has ended its flight toward the goal of its wandering on the other side of the ocean, so the strong desire of knowledge, inborn in the human soul, nowhere finds a resting-place and entire content, until it reaches the end of its strivings, the knowledge of a Divine Being, the Creator, in the midst of the beautiful works of his creation. And that, which can exalt itself to the knowledge of a Divine being, must itself be of a divine species and nature.

#### VALENTINE JAMERAY DUVAL.

We will consider another instance which may teach us how the force, which urges onward the human mind, as the migratory instinct urges the bird, and leads it from the home of sensible perception into the world of a spiritual knowledge, works its way through all obstacles and outward obstructions, and at last reaches its distant goal, as surely as the stork his nest, when he returns from Africa.

In the before mentioned case of Laura Bridgman, as well as in other cases of blind mutes, one might suppose that the simple circumstance of their being deprived of all the pleasures of the higher senses, may have kindled the thirst for inward, spiritual activity, and the desire for knowledge. Had Laura, like other sound children, been able to see and hear, then,

so it may be thought, her inquisitive spirit would not have shown itself so powerfully as it did; she would have been satisfied with the usual measure of knowledge.

It is indeed to a certain extent true that the spiritual force in men develops itself the more easily and the more powerfully, the less it is dissipated by the enjoyment of the senses, or diverted from its true path. The hovel of poverty has indeed often been the birthplace of great and world-renowned men, but neither the hovels nor the poverty of their parents have made them what they became, but the inward call of the spirit of the Creator in their spirits. Laura, even though she had possessed the usual faculties of the senses, would have been a remarkable child. The celebrated Italian painter, Giotto, who, as a poor herds-boy, drew figures with charcoal on the rocks, would have been a great artist, even had his master Cimabue found him, not in the field with the cows, but as the son of a nobleman in a rich mansion. For the inward call regards neither rank nor place of birth. It can raise the son of a peasant slave up to the rank of a distinguished soldier, the son of a poor man to the station of a prime minister. Whosoever is called to a great work in art or science, cannot be diverted from his destiny by noble birth, with all its sensual dissipations, nor by the poverty of the paternal abode. The Creator, who feeds the young ravens when they cry, knows also how at the right time to awaken the power which he has placed in human beings and in the desert which surrounds them, to furnish it with the necessary nourishment. The great variety in plants, trees and animals, corresponds in the race of man, intellectually considered, to the great variety of talents and gifts; and as all things are so arranged, that every animal finds its appropriate food and abode, so the tender care of eternal wisdom is seen still more strikingly when it endows and prepares individual men, each for his future career in life.

With special interest, therefore, will every one who finds pleasure in observing the ways of God among men, contemplate the history of Valentine Jameray Duval, who by the remarkable guidance of his native spiritual force became, from an ignorant, starving beggar-boy, the highly respected librarian

and keeper of the collection of coins of a great emperor, and through the energy of his own mind, a celebrated scholar.

The time of Jameray Duval's birth, the year 1695, fell in the brilliant days of French conquest under Louis XIV., a period noted also for the great internal distress which France then suffered. Heavy taxes oppressed the land. The flower of its youth were dragged away to battle and there sacrificed; in many places the soil lay untillied for want of labourers; the crops failed, trade and commerce were ruined by war; everywhere were families mourning for a son or a brother, or father who had fallen in the war which was waged to gratify the ambition of the king. The soil of Champagne is one of the poorest in all France. There lies the little village of Artenay, in which the house of Duval's parents was one of the meanest. For the father, a poor peasant, died when Valentine was but ten years old, and left to the mother the care of a numerous family, for whose subsistence the small means remaining to the widow did not suffice in the then great scarcity. There was daily lamentation in the poor household, the younger children crying for bread, and the elder ones becoming hardened to hunger and toil. Yet in Valentine there was a native power which became only the more indomitable, the sorer the necessity was. What was wanting without was richly supplied from within by a cheerful temper, for he was the liveliest boy in the village, delighting the other children with his fun, and animating their plays with his merry devices. He had barely learned to read in the village school when in his twelfth year he entered the service of a peasant. The care of young turkeys entrusted to him by his master, during the summer, was rather an irksome business for his lively spirit. It may not therefore be wondered at that the boy fell upon methods of amusing himself, which were not always happily chosen. Among other things he had heard that red colours drove turkeys mad. He wished to try the truth of this saying, and accordingly he tied a piece of red cloth round the neck of one of his flock. The animal fell into a violent rage, struggled in vain to free himself from the cloth, and then, not allowing himself to be caught or held, fluttered about till he fell dead. His master imme-



diately drove the boy from his service, and as no other employment was to be found in the village, and his mother was too poor to support him, he set off to find subsistence abroad.

It was in the winter of 1708-9, unquestionably the severest known for a century, when the boy Duval commenced his first wandering in the broad world. The cold, which reached its greatest intensity after Epiphany, January 5th, 1709, was so frightful that no one ventured to leave his house or his fireside without the most urgent necessity, for accounts were daily heard of persons found frozen to death on the highways and in houses. All places of public assemblies, the courts of justice, and even churches were deserted. Wine and water could not be kept in a fluid state for the service of the altar. Wine in cellars hardened into ice. The cattle in their stalls perished, the animals in the forests, quadrupeds and birds approached the dwellings and hearths of men to seek protection there against the terrible cold, and food, which was elsewhere buried deep under the snow. Birds fell powerless from the air, the fish died in the ponds, which were frozen to their lowest depths. The seed in the fields and the vines were ruined, trees in gardens and even the trunks of forest trees snapped with the cold, rocks were split and thrown down. It was several years before the traces of the desolation which that winter had caused were in any degree obliterated. Vineyards and olive plantations had to be laid out anew. For more than a generation maimed people were to be met with on crutches, who had lost their limbs not in war, but in consequence of freezing, under the knives and saws of the surgeons.

Even in those days when the winter began to be the hardest, young Duval wandered, from place to place, along the deserted roads, to seek service and a refuge from frost and hunger. To both these perils, there came a third, the hardest of all, which threatened to put a sudden end to his life, and which was nevertheless sent to his rescue from the otherwise inevitable death by freezing and starvation. On the way between Provence and Brie, near a farmer's house, he was seized with so terrible a pain in his head that it seemed to him as if the bones of his skull would

break apart, and his eyes start out of their sockets. With difficulty could he drag himself to the door of the neighbouring house, and implore the person who opened it to him, to show him a corner where he might warm himself and recover from the distressing pain. He was shown the barn among the sheep, and the gentle warmth which was diffused there by the breath and perspiration of the numerous animals, was more beneficial to him than a heated room in the best dwelling-house could have been. His limbs soon lost their stiffness, but the pain in his head became so violent that it robbed him of his senses. When, the next morning, the farmer entered the barn and saw the boy's eyes sparkling and inflamed with fever, his swollen countenance covered with red pustules, he was not a little startled. He instantly told the poor sick child that he had the small-pox and must certainly die, because he was too weak and wretched to go or to be carried to a place where he would be better taken care of, for there in that poor-house there was no means of affording him the scantiest subsistence during so long a sickness. The sick boy was unable to speak a word. His condition touched the farmer; he went into his house and brought thence a bundle of old linen rags, in which, after he had with difficulty undressed Duval, he wrapt him as a mummy. There in the barn lay the dung of the sheep heaped up in rows; between these the farmer made a couch of the chaff which had fallen from the winnowed oats, laid the boy upon it, covered him to his neck with chaff, and then with layers of the manure. As when a dead body is deposited in the grave, the compassionate farmer, when he had finished the work of covering the boy up, placed a cross over him, commended him to God and his saints, and as he departed repeated several times the assurance that only a miracle could save him from the death, to all appearances, so nigh at hand.

(To be Continued.)

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TRUTH.—He that finds truth, without loving her, is like a bat; which, though it have eyes, to discern that there is a sun, yet hath so evil eyes, that it cannot delight in the sun.—*Sir P. Sidney.*

## FAMILIAR CONVERSATIONS ON INTERESTING SUBJECTS.

Mrs. Wilson was sitting in her room, sewing one day, in the early part of March, when her little daughter came running in, in great glee. In her hand, she held a bunch of beautiful flowers.

"Look, mother," she cried, "what a lovely bouquet Mrs. Haybrook has sent me from town."

"Rather out of the common order of things, isn't it Clara, to send flowers from the town to the country: but I suppose they are hot-house plants?"

"Oh yes! mother they must be; but are they not beautiful?"

"Beautiful, indeed, Clara; and how sweetly they smell too: why the room is filled with their perfume already."

"Mother, can you tell me what it is that causes the odour or perfume of flowers?"

"Botanists account for it in some measure; but it is generally considered to be beyond human observation."

"What do they say about it?"

"They say it arises from the volatile oils, formed by the corolla."

"Volatile oils, formed by the corolla! I don't know what that means, mother?"

"Volatile, means passing off by evaporation—the corolla, is the blossom-part of the flower; if the heat is very great, these oils evaporate faster than they are formed; if it is too feeble, they scarcely evaporate at all. Under both these circumstances, flowers seem to have very little smell."

"Then I suppose, mother, that is the reason why flowers generally seem more fragrant in the morning and evening, than they do in the middle of the day?"

"Yes, for then the heat being neither too great nor too little, these oils evaporate just fast enough to form a perfumed atmosphere around the flowers."

"But, mother, this seems very plain I think; what did you mean when you said a little while ago, it was beyond our observation?"

"I alluded to the particular way in which these oils were formed by the corolla: that, as well as the secretion of nectary, appear to be hidden mysteries

of the Great Author of Nature, which our limited faculties are not permitted to comprehend."

"Nectary, is a sweet juice something like honey which is found in many flowers, isn't it, mother?"

"Yes; and if it answers no other purpose, we know it affords food for bees and other insects."

"Was the science of botany known to the ancients, mother?"

"It was to a certain extent; but like other branches of natural science it had much to contend with. It is said of Solomon, you know, that 'he spake of trees; from the cedar-tree that is in Lebanon, even unto the hyssop, that springeth out of the wall; and people from all countries came to hear his wisdom.' Pythagoras, Aristotle, Theophrastus, and other philosophers wrote on this subject, but as the descriptions which they gave of plants were without any system, their works were of little use. Dioscorides gave the names and properties of 600 plants, but having no idea of species or genera, it amounted to little or nothing."

"I don't understand what you mean by 'species or genera,' mother?"

"Naturalists have reduced all known vegetable productions on the surface of the globe into classes, orders, genera, and species. The classes are composed of orders, the orders of genera, and the genera of species."

"Who made this division, mother?"

"Charles Von Linnæus, a native of Sweden, who has justly been styled by scientific men, the 'Prince of Naturalists.' I will endeavour to procure you the history of his life which you can read at your leisure, and which I am sure you will be pleased with."

"Has it been long since his time, mother?"

"He was born in 1707, and died in 1778."

"But what particular advantages are to be derived from having plants divided in this manner, mother?"

"It enables a person acquainted with botany, to determine at a glance almost the particular class and family to which any plant may belong. To the traveller, more particularly, its advantages are felt;



for oftentimes they come across plants unknown to them before, which a knowledge of this science enables them at once to refer to their proper station."

"But how are these different classes, &c., known from each other, mother? there must be some distinguishing mark."

"Yes, there is; but in order to understand this distinction perfectly, it is necessary to have some acquaintance with the different parts of a flower. Give me a lily from your bouquet, and I will tell you the names of these different parts."

Clara did so.

"Now," continued Mrs. Wilson, taking the lily in her hand, "this part which you call the blossom, is, as I have already told you, the corolla; tell me of how many parts it is composed?"

"Six," answered Clara.

"Six, yes; well each of these six parts is called a petal. Now, what do you observe within the corolla?"

"Six little threads like, with a sort of knob at the end, and—"

"Not too fast; these little things like threads are termed stamens; the long slender part is called the filament; and the little knob the anther. Now, what else is there?"

"A stem, I suppose I might call it, which rises in the centre, above the stamens."

"This stem as you call it, is the pistil: it consists of three parts: this top part is termed the stigma; the long slender part the style; and this bottom part the germ."

"The germ contains the seeds, doesn't it, mother?"

"Yes; and when ripe it is termed the pericarp; the seeds are termed ovules. The anther, I should have told you, contains the pollen or dust, which serves to give life to the young seed."

"How does the pollen reach the germ, mother?"

"When the flower is ripe, the anthers burst, and the pollen is scattered: insects too, in search of honey, disturb the dust of the stamens."

"Are these all the parts of the flower, mother?"

"No: the end of the flower stem where these petals are inserted, is termed the receptacle. These are all the parts of the lily, but there is another part, which,

although found in most flowers, is wanting here."

"You mean that little green thing like a cup, don't you, mother, at the bottom of the corolla? Here is one on this pink."

"Yes, that is what I allude to: this little green cup is called the calyx. Now let me hear if you can explain the different parts of a flower?"

"First then, I suppose it is the calyx, which surrounds the corolla—?"

"The different parts of the calyx, I should have told you, are called sepals."

"Next the corolla or blossom part of the flower; the parts of which are called the petals; within the corolla are the stamens; the parts are the anther, which contains the pollen, and the filament which supports the anther; then in the centre of the stamens is the pistil, composed of the germ, the style, and the stigma; and the last is the receptacle which supports the other parts of the flower. That is all, isn't it, mother?"

"In the mature plant, there are two other parts—?"

"Oh! yes: the pericarp and the seed."

"You have done very well, Clara: that, I think is as much as your mind ought to be burdened with at one time: so we will leave the subject for the present."

## COPERNICUS.

NICHOLAS COPERNICUS was born at Thorn, Prussia, in 1473. In early life he manifested a decided taste for mathematics and astronomy. He passed through a regular course of study in medicine and philosophy, but he left them for the pursuit of what most pleased his taste. At the age of twenty-three he had the reputation of a skilful observer of the heavens, and was appointed a professor in one of the institutions of his country.

At that period it was the opinion of all the philosophers, that the earth was the centre of the universe, and that the changes of day, and the seasons, were produced by the revolutions of the planets around it. Copernicus was not satisfied with these ideas, and declared that the sun was the centre of the solar system, and that the earth revolved around it from west to east.

He watched the motions of the planets, collected facts, and made all possible observations to substantiate his theory. The results of his labours were the discovery of that system now so universally taught, and named in honour of him who first promulgated it—the Copernican system.

He was a martyr to science, as others have since been, who have dared to teach theories contrary to the generally received opinions of their age. The following History of the Last Days of Copernicus will give a graphic idea of the persecutions he suffered :

It was a still, clear night in the month of May, 1543 ; the stars shone brightly in the heavens, and all slept in the little town of Wernica, a canonry of Prussian Poland, save one man, who watched alone in a solitary chamber, at the summit of a lofty tower. The only furniture of this apartment consisted of a table, a few books, and an iron lamp. Its occupant was an old man of about seventy, bowed down by years and toil, and his brow furrowed by anxious thoughts ; but his eye kindled with the fire of genius, and his noble countenance was expressive of gentle kindness, and of a calm, contemplative disposition.

This old man was the astronomer, Nicholas Copernicus. He had just completed his work "On the Revolutions of the Heavenly Bodies." In the midst of poverty, ridicule, and persecution, with no other support than that of his own modest genius, or any instrument save a triangle of wood, he had unveiled heaven to earth, and was now approaching the term of his career, just as he had established on a firm basis those discoveries which were destined to change the whole face of astronomical sciences.

On that very day he had received the last proof-sheets of his book, which his disciple, Rheticus, was getting printed at Nuremberg ; and, before sending back those final proofs, he wished to verify for the last time the results of his discoveries. Heaven seemed to have sent him a night expressly fitted for the purpose, and he passed the whole of it in his observatory.

When the astronomer saw the stars beginning to pale in the eastern sky, he took the triangular instrument which he had constructed with his own hands, out of three pieces of wood, and directed it suc-

cessively toward the four cardinal points of the horizon. No shadow of a doubt remained, and overpowered by the conviction that he had *indeed* destroyed an error of five thousand years' duration, and was about to reveal to the world an imperishable truth, Copernicus knelt in the presence of that glorious volume whose starry characters he had first learned to decipher, and folding his attenuated hands across his bosom, thanked his Creator for having opened his eyes to understand and read aright these His glorious works.

He then returned to the table, and, seizing a pen, wrote on the title-page of his book, "Behold the work of the greatest and the most perfect Artisan—the work of God himself." And now, the first excitement having passed away, he proceeded with a collected mind to write the dedication of his book :

"To the Most Holy Father, Pope Paul III:—I dedicate my work to your holiness, in order that all the world, whether learned or ignorant, may see that I do not seek to shun examination and the judgment of my superiors. Your authority, and your love for science in general, and for mathematics in particular, will serve to shield me against wicked and malicious slanders, notwithstanding the proverb which says that there is no remedy against the wounds inflicted by the tongue of calumny, &c.

"NICHOLAS COPERNICUS."

Soon the first dawn of day caused the lamp of the astronomer to burn more dimly ; he leaned his forehead upon the table, and, overcome with fatigue, sank into a peaceful slumber. After sixty years' of labour, he in truth needed repose. But his present rest was not destined to be of long duration. An aged servant, with slow and heavy steps, ascended the tower stairs.

"Master," said he, as he gently touched the sleeping astronomer upon the shoulder, "the messenger who arrived yesterday from Rheticus is ready to set out on his return, and is waiting for your proof-sheets and letters."

Copernicus arose, made up the packet, which he duly sealed, and then sank back upon his chair, as if wearied by the effort.

"But that is not all," continued the



servant; "there are ten poor, sick people in the house waiting for you; and besides, you are wanted at Frauenburg to look after the water-machine, which has stopped working; and also to see the three workmen who broke their legs in trying to set it going again."

"Poor creatures!" exclaimed Copernicus, "let my horse be saddled directly." And with a resolute effort, shaking off the sleep which weighed down his eyelids, the good man hastily descended the stairs of the tower.

The house of Copernicus was, in outward appearance, one of the most unpretending in Wernica. It was composed of a laboratory, in which he prepared medicine for the poor; a little studio, in which this man of genius, skilled in art as well as science, painted his own likeness or those of his friends, or traced his recollections of Rome or Bologna; and lastly, of a small parlour on the ground-floor, which was open for all who came to him for remedies, for money, or for food.

Over the door an oval aperture had been cut, through which a ray of the mid-day sun daily penetrated, and, resting upon a certain point in the adjoining room, marked the hour of noon. This was the astronomical gnomon of Copernicus; and the only ornaments the room contained were some verses written by his own hand, and pasted up over the chimney-piece.

It was in this parlour that the good man found room to tend invalids who had come to claim his assistance; dressed the wounds of some, administering remedies to others, and on all bestowed alms and words of kindness and consolation. Having completed his labours, he hastily swallowed a draught of milk, and was about to set out to Frauenburg, when a horseman, galloping up to the door, handed him a letter. He trembled as he recognized the handwriting of his friend Gysius, Bishop of Culm.

"May God have pity on us," wrote this friend, "and avert the blow which now threatens thee! Thy enemies and thy rivals combined—those who accuse thee of folly, and those who treat thee as a heretic—have been so successful in exciting against thee the minds of the people of Nuremberg, that men curse thy name in the streets; the priests excommunicate

thee from their pulpits; and the University, hearing that thy book was to appear, has declared its intention to break the printing-press of the publisher, and to destroy the work to which thy life has been devoted. Come and allay the storm; but come quickly, or thou wilt be too late."

Before Copernicus had finished the perusal of this letter, he fell back voiceless and powerless into the arms of his faithful servant, and it was some moments before he rallied. When he again looked up, the horseman who had been charged to escort him back, asked him how soon he would wish to set out.

"I must set out directly," replied the old man, in a resigned tone; "but not for Nuremberg, or for Culm; the suffering workmen at Frauenburg are expecting me; they may perhaps die, if I do not go to their assistance. My enemies may perhaps destroy my work, but they cannot stop the stars in their courses."

An hour later, Copernicus was at Frauenburg. The machine was soon in order, and in a few hours the water flowed freely into the town. His first cares, we need not say, had been directed to the unhappy men who had received injuries whilst working in the sluices. He set their fractured limbs, and bound them up with his own hands; then commending them to the care of an attendant, he promised to return and visit them on the morrow. But a blow was about to descend upon himself, which was destined to crush him to the dust.

As he crossed the square, whilst passing through the town on his return home, he perceived among a crowd a company of strolling players acting upon a temporary stage. The theatre represented an astronomical observatory, filled with all kinds of ridiculous instruments. In the midst stood an old man, whose dress and bearing were in the exact imitation of those of Copernicus. The resemblance was so striking, that he directly recognized himself, and paused, stupified with astonishment.

Behind the merry Andrew, whose business it was to hold up the great man to public derision, there stood a personage whose horns and cloven foot designated Satan, and who caused the pseudo-Copernicus to act and speak, as though he had.

been an automaton, by means of two strings fastened to his ears, which were no other than asses' ears, of considerable dimensions.

The parody was composed of several scenes. In the first, the astronomer gave himself to Satan, burnt a copy of the Bible, and trampled a crucifix underfoot. In the second, he explained by juggling with apples in guise of planets, whilst his head was transformed into a likeness of the sun by means of torches of rosin. In the third, he became a charlatan, a vender of pomatum and quack medicine. In the fourth and closing act he was dragged forth as one accursed by God and man; and the devil dragging him down to the infernal regions amidst a cloud of sulphurous smoke, declared his intention to punish him for having caused the earth to turn on its axis, by condemning him to remain with his head downwards throughout eternity.

When Copernicus thus beheld the treasured discoveries of his whole life held up to the derision of an ignorant multitude, his enlightened faith blinded as impiety, and his self-denying benevolence ridiculed as the quackery of a charlatan, his noble spirit was at first utterly overwhelmed, and the most fearful doubts of himself, of mankind, and even of Providence itself, rushed upon his mind.

At first he hoped that the Frauenburgians, the children of his adoption, to whose comfort and happiness he had devoted himself for fifty years, would cut short the disgraceful scene. But, alas! he saw his defamers welcomed with applause by those on whom he had conferred so many benefits. The trial was too much for his failing strength; and, worn out by the emotion and fatigue of the preceding night, and, by the labours of the morning, he sank exhausted to the ground.

Then, for the first time, did the ungrateful multitude recognise their benefactor; the name of Copernicus flew from lip to lip; they heard that he had come that very morning to the town to relieve their distress. In a moment the current of popular feeling was turned, the crowd dispersed the actors, and crowded anxiously around the astronomer. He had only strength left to call for a litter, and was conveyed back to Wernica in a dying

state. He lingered, however, for five days—days of trial and anxiety—during which the lamp of genius and faith still shed its halo around the dying man.

On the day succeeding his visit to Frauenburg, a letter from Rheticus confirmed the sinister predictions of the Bishop of Culm; thrice had the students of the university made an attempt to invade the printing-office when the truth was about to issue forth.

"Even this very morning," wrote his friend, "a set of madmen tried to set fire to it. I have assembled all our friends within the building, and we never quit our posts, either day or night, guarding the entrance, and keeping watch over the workmen. The printers perform their work with their pistols at hand. If we can stand our guard for two days, the book is saved; for, let only ten copies be struck off, and nothing will any longer be able to destroy it. But if either to-day or to-morrow our enemies should succeed in gaining the upper hand"—

Rheticus left the sentence unfinished, but Copernicus supplied the want; he knew how much depended upon this moment. On the third day another messenger made his appearance, and he, too, was the bearer of evil tidings: "A compositor, gained over by our enemies, has delivered into their hands the manuscripts of the book, and it has been burned in the public square. Happily the impression was complete, and we are now putting it to press. But a popular tumult might yet ruin all."

Such was the state of suspense in which the great Copernicus passed the closing days of his existence! Life was ebbing fast, and the torpor of death had already begun to steal over his faculties, when a horseman galloped up to the door in breathless haste, and, springing from his horse, hastened into the house of the dying astronomer. A volume, whose leaves were still damp, was treasured in his bosom; it was the *chef-d'œuvre* of Copernicus; this messenger was the bode of victory.

The spark of life, so nearly exhausted, seemed to be rekindled for a moment in the breast of the dying man; he raised himself in his bed, grasped the book with his feeble hand, and glanced at its contents with his dim, expiring eye. A smile lighted



up his features, the book fell from his grasp, and clasping his hands together, he exclaimed, "Lord, now let thy servant depart in peace!" Hardly had he uttered these words, before his spirit fled from earth to return to God who gave it.

It was the morning of the 23rd of May, 1543, heaven was still lighted with stars; the earth was fragrant with flowers; all Nature seemed to sympathise with the great revealer of her laws; and soon the sun, rising above the horizon, shed its earliest and purest ray upon the still, cold brow of the departed, and seemed in his turn to say, "The king of creation gives the kiss of peace, for thou hast been the first to place him on his throne."

### ARCHITECTURE OF THE EYE.\*

HEAR with what swelling words of vanity man proclaims the majesty of his intellect, and the might of his single arm! The "cunning artisan" shall do it, and man shall be lifted to everlasting honour! The clay has laughed to scorn the skill of the potter; the creature, offspring of yesterday, has defied his Creator, whose being is eternity!

Go to, thou boaster! make ready! for the God of Nature accepts the challenge, and demands the trial. No space is left whereon to build another universe; but the *eye* is a little and familiar thing, which an inch will more than span. Upon this "inch" let the wager be laid, and all earth shall stand umpire, while our hopes of a final resurrection and a blessed immortality we plight against the bold adventure.

Build first the walls of defence, the socket, the cheek, and the nasal bones, and the projecting arch above, which shall guard the eye from external violence. Plant the eyebrows in just proportion and arrangement, like tiles so overlapping, and of such exact form and length, as that the acrid perspiration which distils from the brows shall be turned upon the open temples; dye them with some dark pigment; and for those who dwell under

the vertical rays of a tropical sun, give a darker hue. Attach a muscle of curious workmanship in mould and fixture, as that at your bidding its thousand fibres shall contract and depress the overhanging thatch.

Work now the lids, of materials soft and pliant; adapt them accurately each to the other, and to the smooth convexity of the eye. Place also the cords which, moved by the intellectual actor behind, shall enable him to raise the curtains, and, looking forth, read in the face of his auditors applause or censure; to be again dropped when the performer needs repose, or when the last great drama is wound up.

Dig a fountain above the outer angle of the lids, where, fed by perennial streams, it shall overflow and wash the adjacent plain. From the fountain draw ten thousand secret wires to the surface of the eye, so watchful and obedient as that, when touched by the smallest mote, they shall suddenly spring the tearful gates, and bear off the offending particle. Let it also be to the mind a safety-valve, to be lifted when pleasure or pain moves the soul to excess; the closure of which, when the passions are in hot ebullition, shall produce disorganization and permanent derangement of the brain.

Excavate at the inner angle a shelving lake, and throw up from its base a rocky islet, well covered with brambles and an oily exudation, designed, when the waters are agitated and cast upon its shores, by the action of the lids, to catch and retain such particles as would obstruct its narrow outlet.

This outlet build of cement finer than purest porcelain, and of capillary dimensions, to absorb the fluids which approach its mouth; endow it with a consciousness of its office and importance; make it irritable and impatient of insult, that when provoked it shall bar its entrance and refuse admission to all, until its tiny wrath is fully appeased.

Arrange along the slender border of each lid minute sacs, stored with unctuous matter, which shall constantly pour their contents from narrow mouths, as oil is laid upon the edge of the brimming bowl to prevent its overflow. Still farther, plant outside of these a double row of lashes, that when the lids are nearly closed,

\*AN ARGUMENT.—"A truly cunning artisan shall construct many things equally deserving of admiration with anything we see in Nature!"—*Martyn's Philos. of Nature.*

they shall, by interlacement, effectually exclude all particles of dust, yet admit the light.

Ah! it is a weary and vexatious task for such unpractised hands! Then rest awhile; for this *inch* of creation, which at first seemed unworthy an artist's hour, is scarce begun! You have raised the walls and built its towers; the gates are hung; you have dug the fountains and the water-pools; you have sheltered all from baneful dews and the scorching sun; but of the beautiful temple within, not a stone is laid nor a timber hewn.

Now mix your ores. Buy silver, gold, platinum, iron, lead, and brass; gather here all your metals, rare and costly, of all degrees of consistency, and strength, and malleability; and when you have carefully selected, fuse them together, and from your crucible mould a crystal like the *cornea*, transparent, tenacious, flexible, smooth, and polished, with the exact convexity and density necessary to a proper refraction and convergence of the rays of light.

Next, form of opaque and stronger materials a case, in which the beveled edge of the *cornea* shall be received, like an optician's lens. Within this globe thus constructed, pour fluids of different densities, as in the perfect achromatic telescope, to combine the rays, and prevent the imperfection of colours.

In the anterior chamber of the eye, let the fluid be thin and pellucid, and inclosed in a fine, transparent capsule, while the posterior chamber must be filled with a more consistent material, like melted glass, and divided into a multitude of minute cellules, by intersecting septa. Between these two, place a double convex lens, of perfect form, its posterior surface the arc of a lesser circle than its anterior. Construct the lens of radiating and concentric fibres, the inner laminæ dense, the outer soft and pulpy. The whole invest with a delicate capsule.

Now mark! if you err in any point, with all these lenses and humours, if there be one minim of fluid too much, or if the lens be one line too convex, or its structure one grain too dense, or the relative proportion of each be changed one fraction, all your labour is vain. You may as well expect with imperfect rules to ascertain

eclipses, or the course and return of the eccentric comet.

Be not faint and discouraged; for, remember, the road to fame was never a "swift highway," but always sadly rough and wearisome, and covered with difficulties thick as rocks upon the mountain sides. Yet it is cheering to know that the diamonds in your crown shall be numbered by the obstacles you have encountered and overcome.

Gird on, for another is before you. But lest your labouring senses rebel at being overtaken, and suddenly depart, leaving your skull an empty cobbler's shop, and this curious work, so well begun, half wrought, you shall invite fresh aid.

Call the shrewd mechanic and cunning artisan; ask counsel of the learned, the mathematician, the geometrician, the chemist; invoke the mysterious science of the Rosicrucian, the sorcerer, and the magician. From all demand knowledge how to weave an *iris*, the *inner curtain*, with its changing *pupil*, formed of circular and diverging fibres, and floating freely in the fluid of the anterior chamber, prompt to dilate when the nerve of vision demands more light, and as prompt to contract when the light is too intense; never moved or excited by the direct infringement of the luminous rays upon its own fibres, but ever faithful and obedient to the calls of the *retina*; and so made that, through the threescore years and ten that it shall serve, watching the while, both night and day, with attentive care, every cloud and shade of the inconstant light, not a string shall loosen nor a thread need repair.

The *retina* form of finest texture, and spread it broad within the back of the eye, like the white canvas of the camera obscura. To absorb the rays and prevent their reflection after they have impinged upon the *retina*, line its posterior surface with a paint which light, however long it may act upon it, shall never fade—an art in colouring not yet attained.

Supply the whole eye with nerves, arteries, veins, and absorbents, for the purposes of growth and reparation; place it upon a nicely-adjusted axis, and give the power of motion and rotation in every conceivable direction; and last, bestow the strange and hitherto inimitable power of adapting its vision to different distances,



without any perceptible change in the form of the organ.

Have you done? And does your careful eye detect no flaw or fissure, no failure or imperfection? Hold it up! It is beautiful and wondrous indeed! But one thing more, and the pledge is yours—*now make it see!* “for truly the light is sweet, and a pleasant thing it is for the eyes to behold the sun.”

Let it at one glance receive and recognize the extended landscape, with all its varieties of feature, and colour, and distance; the valley, and mountain with its hoary locks; the forest and the rich harvest-fields; the meadow, the pearly lake, the rippling, ever-babbling brook, the village—

“Dim described in the distant plain,” the clouds—airy messengers, which come and go in ceaseless procession, like spirits sent from heaven on hasty errands.

Animate it with life, intelligence, sentiment, and passion; make it the door and window of the soul, through which “all without may look in, and all within may look out”—

“The gay recess of wisdom and of wit.  
And passions’ host, that never brook’d control.”

In sorrow let it be dimmed and sad; in terror, wild and restless. But to the eye of the angry man, give fire; let a savage brightness shoot from its dark and stormy surface, like lightning amid the blackness of a tempest; and when despair seizes the soul, knit the brows convulsively, and fix the eye in a fierce and sullen glare.

Imprint, also, the finer sentiments. In joy, teach it to sparkle and beam with a mild and radiant light: in love and deep affection, to glow with a warm and melting softness. Here paint innocence and modesty with a sweet and lovely harmony, such as angels look. Benevolence, kindness, charity, patience—the choicest virtues—all holy passions and unholy, both good and evil, must be here depicted; and give it not the blank look of your dumb automaton, until death approaches.

“All flesh must perish;” and as the soul loosens from its mysterious connection, fasten the sightless ball in the gaze of insensibility, and let a cold dampness distil from its surface to dim its lustre. Lighten it a moment with a celestial

splendour, as if to announce the spirit’s departure; then let its brightness cease for ever. Oh, foolish man! How vain are all your boastings, and how dwindled your greatness, when compared with Him “who laid the deep foundations of the earth, and spread the heavens abroad!”

\* \* \* \* \*

Thou hast listened to the song of a siren, and it was the song of Lucifer, “bright son of the morning,” who, war- ring for the throne and sceptre of God, was hurled from the battlements of heaven. Thou hast listened until thine own harp is attuned with most discordant strains; and thy erring feet have been lured to almost where the portals of eternal night shut out the day.

But a new harp is struck, and another song comes gathering upon the air; it is the song of Nature. From the woodlands and the heath, from hill-top and sequestered dell, it comes, and it saith, “There is a God!” It is heard in the rustling of the forest leaves, in the warbling of the morning birds, in the whispers of the evening breeze, in the “warm hum of the insects by the side of the babbling brook,” in the waterfall, in the rushing of the tempest, and the hollow murmur of the ocean tide; and in all it saith, “There is a God!” It speaks in the booming thunder, and is echoed by the broad mountain-side—from all around, above, beneath, a choral anthem is raised, and the voice of every thing is heard to say, in harmonious melody, “There is a God, the Maker and Ruler of all things.”

### AN UPRIGHT JUDGE.

THE character of Sir Matthew Hale as a judge was splendidly pre-eminent. His learning was profound; his patience unconquerable; his integrity stainless. In the words of one who wrote with no friendly feeling towards him, “his voice was oracular, and his person little less than adored.” The temper of mind with which he entered upon the duties of the bench is best exemplified in the following resolutions, which appear to be composed on his being raised to the dignity of chief baron at the restoration.

“Things necessary to be continually had in remembrance:—

"1. That in the administration of justice I am intrusted for God the, king, and country; and therefore,

"2. That it be done—1. uprightly; 2. deliberately; 3. resolutely.

"3. That I rest not upon my own understanding or strength, but implore and rest upon the direction and strength of God.

"4. That in the exertion of justice I carefully lay aside my own passions, and not give way to them, however provoked.

"5. That I be wholly intent upon the business I am about, remitting all other cares and thoughts as unseasonable and interruptions.

"6. That I suffer not myself to be prepossessed with any judgment at all, till the whole business and both parties be heard.

"7. That I never engage myself in the beginning of any cause, but reserve myself unprejudiced till the whole be heard.

"8. That in business capital, though my nature prompt me to pity, yet to consider there is a pity also due to the country.

"9. That I be not too rigid in matters purely conscientious, where all the harm is diversity of judgment.

"10. That I be not biassed with compassion to the poor, or favour to the rich, in point of justice.

"11. That popular or court applause, or distaste, have no influence in anything I do, in point of distribution of justice.

"12. Not to be solicitous what men will say or think, so long as I keep myself exactly according to the rule of justice.

"13. If in criminals it be a measuring cast, to incline to mercy and acquittal.

"14. In criminals that consist merely in words, where no more harm ensues, moderation is no injustice.

"15. In criminals of blood, if the fact be evident, severity is justice.

"16. To abhor all private solicitations, of what kind soever, and by whomsoever, in matters depending.

"17. To charge my servants—1. Not to interpose in any matter whatsoever; 2. Not to take more than their known fees; 3. Not to give any undue precedence to causes; 4. Not to recommend counsel.

"18. To be short and sparing at meals, that I may be the fitter for business."

Under the influence of resolutions like these, the conduct of Hale on the bench appears to have been almost irreproachable.

## WHAT IS TIME?

BY THE REV. JOSHUA MARSDEN.

I ASK'D an aged man—a man of cares,  
Wrinkled and bent, and white with hoary  
hairs;

"Time is the warp of life," he said—"oh, tell  
The young, the gay, the fair, to weave it  
well!"

I asked the ancient venerable dead,  
Sages who wrote, and warriors who bled;  
From the cold grave a hollow murmur  
flow'd,

"Time sow'd the seed we reap in this abode!"  
I ask'd a dying sinner, ere the tide  
Of life had left his veins,—“Time!” he  
replied,

“I’ve lost it!—ah! the treasure!” and he  
died.

I ask'd the golden sun, and silver spheres,  
Those bright chronometers of days and  
years;

They answer'd—“Time is but a meteor  
glare,”

And bade us for eternity prepare.  
I ask'd the Seasons, in their annual round  
Which beautify or desolate the ground;  
And they replied (no oracle more wise)  
“’Tis Folly’s bank, and Wisdom’s highest  
prize!”

I ask’d a spirit lost; but, oh, the shriek  
That pierced my soul! I shudder while I  
speak!

It cried, “A particle—a speck—a mite  
Of endless years’ duration infinite!”  
Of things inanimate, my dial I

Consulted,—it made me this reply,—  
“Time is the season fair of living well,  
The path of glory, or the path of hell.”  
I ask’d my Bible, and methinks it said,  
“Time is the present hour, the past is fled:  
Live! live to-day, to-morrow never yet  
On any human being rose or set.”

I ask’d old father Time himself at last,  
But in a moment he flew swiftly past;  
His chariot was a cloud, the reinless wind  
His noiseless steeds, which left no trace  
behind.

I ask’d the mighty Angel, who shall stand  
One foot on sea, and one on solid land;  
“By Heavens! I swear the mystery’s o’er;  
Time was,” he cried, “but Time shall be no  
more!”



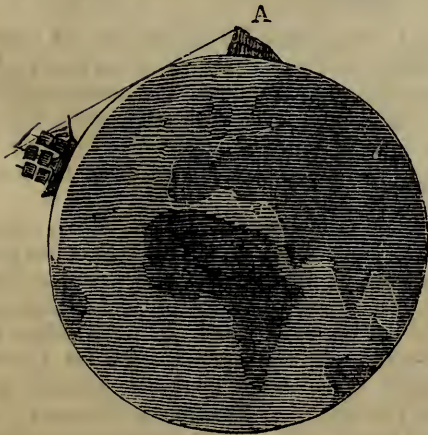
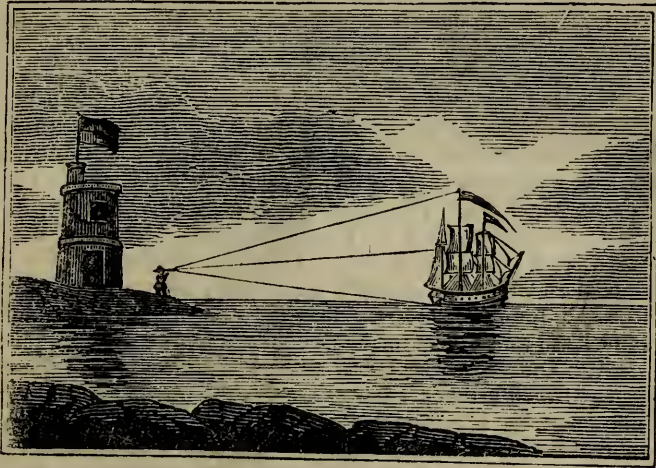
# POPULAR ASTRONOMY.

## LETTER III.

### FIGURE OF THE EARTH.

" He took the golden compasses prepared  
In God's eternal store to circumscribe  
This universe, and all created things;  
One foot he centred, and the other turned  
Round through the vast profundity obscure,  
And said, 'Thus far extend, thus far thy bounds,  
This be thy just circumference, O World!'"—*Milton.*

IN the earliest ages, the earth was regarded as one continued plane; but, at a comparatively remote period, about five hundred years before the Christian era, astronomers began to entertain the opinion that the earth is round. We are able now to adduce various arguments which severally prove this truth, when a ship is coming in from sea, we first observe only her very highest parts, while her lower portions come successively into view. Now were the earth a continued plane, the lower parts of the ship would be visible as soon as the higher, as is evident from Fig. 3.



Since light comes to the eye in straight lines, by which objects become visible, it is evident, that no reason exists why the parts of the ship near the water should not be seen as soon as the upper parts. But if the earth be a sphere, then the line of sight would pass above the deck of the ship, as is represented in Fig. 4: and as the ship draws nearer to land, the lower parts would successively rise above this line and come into view exactly in the manner known to observation. Secondly, in a lunar eclipse, which is occasioned by the moon's passing through the earth's shadow, the figure of the shadow is seen to be spherical, which could not be the case unless the earth itself were round. Thirdly, navi-

gators, by steering continually in one direction, as east or west, have in fact come round to the point from which they started, and thus confirmed the fact of the earth's rotundity beyond all question. One may also reach a given place on the earth, by taking directly opposite courses. Thus, he may reach Canton in China, by a westerly route around Cape Horn, or by an easterly route around the Cape of Good Hope. All these arguments severally prove that the earth is round.

But I propose, in this Letter, to give you some account of the unwearied labours which have been performed to ascertain the *exact* figure of the earth; for although the earth is properly described in general language as round, yet it is not an exact sphere. Were it so, all its diameters would be equal; but it is known that a diameter drawn through the equator exceeds one drawn from pole to pole, giving to the earth the form of a *spheroid*,—a figure resembling an orange, where the ends are flattened a little and the central parts are swelled out.

Although it would be a matter of very rational curiosity, to investigate the precise shape of the planet on which Heaven has fixed our abode, yet the immense pains which have been bestowed on this subject have not all arisen from mere curiosity. No accurate measurements can be taken of the distances and magnitudes of the heavenly bodies, nor any exact determinations made of their motions, without a correct knowledge of the figure of the earth; and hence is derived a powerful motive for ascertaining this element with all possible precision.

The first satisfactory evidence that was obtained of the real figure of the earth was derived from reasoning on the effects of the earth's *centrifugal force*, occasioned by its rapid revolution on its own axis. When water is whirled in a pail, we see it recede from the centre and accumulate upon the sides of the vessel; and when a millstone is whirled rapidly, since the portions of the stone furthest from the centre revolve much more rapidly than those near to it, their greater tendency to recede sometimes makes them fly off with a violent explosion. A case, which comes still nearer to that of the earth, is exhibited by a mass of clay revolving on a potter's wheel, as seen in the process of making earthen vessels. The mass swells out in the middle, in consequence of the centrifugal force exerted upon it by a rapid motion. Now, in the diurnal revolution, the equatorial parts of the earth move at the rate of about one thousand miles per hour, while the poles do not move at all; and since, as we take points at successive distances from the equator towards the pole, the rate at which these points move grows constantly less and less; and since, in revolving bodies, the centrifugal force is proportioned to the velocity, consequently, those parts which move with the greatest rapidity will be more affected by this force than those which move more slowly. Hence, the equatorial regions must be higher from the centre than the polar regions; for, were not this the case, the waters on the surface of the earth would be thrown towards the equator, and be piled up there, just as water is accumulated on the sides of a pail when made to revolve rapidly.

Huyghens, an eminent astronomer of Holland, who investigated the laws of centrifugal forces, was the first to infer that such must be the actual shape of the earth; but to Sir Isaac Newton we owe the full development of this doctrine. By combining the reasoning derived from the known laws of the centrifugal force with arguments derived from the principles of universal gravitation, he concluded that the distance through the earth, in the direction of the equator, is greater than that in the direction of the poles. He estimated the difference to be about thirty-four miles.

But it was soon afterwards determined by the astronomers of France, to ascertain the figure of the earth by actual measurements, specially instituted for that purpose. Let us see how this could be effected. If we set out at the equator, and travel towards the pole, it is easy to see when we have advanced one degree of latitude, for this will be indicated by the rising of the north star, which appears in the horizon when the spectator stands on the equator, but rises in the same proportion as he recedes from it, until, on reaching the pole, the north star would be seen directly over head. Now, were the earth a perfect sphere, the meridian of the earth would be a perfect circle, and the distance between any two places, differing one degree in latitude,



would be exactly equal to the distance between any other two places, differing in latitude to the same amount. But if the earth be a spheroid, flattened at the poles, then a line encompassing the earth from north to south, constituting the terrestrial meridian, would not be a perfect circle, but an ellipse, or oval, having its longer diameter through the equator, and its shorter through the poles. The part of this curve included between two radii, drawn from the centre of the earth to the celestial meridian, at angles one degree asunder, would be greater in the polar than in the equatorial region; that is, the degrees of the meridian would lengthen towards the poles.

The French astronomers, therefore, undertook to ascertain by actual measurements of arcs of the meridian, in different latitudes, whether the degrees of the meridian are of uniform length, or, if not, in what manner they differ from each other. After several indecisive measurements of an arc of the meridian in France, it was determined to effect simultaneous measurements of arcs of the meridian near the equator, and as near as possible to the north pole, presuming that if degrees of the meridian, in different latitudes, are really of different lengths, they will differ most in points most distant from each other. Accordingly, in 1735, the French Academy, aided by the government, sent out two expeditions, one to Peru and the other to Lapland. Three distinguished mathematicians, Bouguer, La Condamine, and Godin, were despatched to the former place, and four others, Maupertuis, Camus, Clairaut, and Lemonnier, were sent to the part of Swedish Lapland which lies at the head of the Gulf of Tornea, the northern arm of the Baltic. This commission completed its operations several years sooner than the other, which met with greater difficulties in the way of its enterprise. Still the northern detachment had great obstacles to contend with, arising particularly from the extreme length and severity of its winters. The measurements, however, were conducted with care and skill, and the result, when compared with that obtained for the length of a degree in France, plainly indicated, by its greater amount, a compression of the earth towards the poles.

Meanwhile Bouguer and his party were prosecuting a similar work in Peru, under extraordinary difficulties. These were caused, partly by the localities, and partly by the illwill and indolence of the inhabitants. The place selected for their operations was in an elevated valley between two principal chains of the Andes. The lowest point of their arc was at an elevation of a mile and a half above the level of the sea; and in some instances, the heights of two neighbouring signals differed more than a mile. Encamped upon lofty mountains, they had to struggle against storms, cold, and privations of every description, while the invincible indifference of the Indians they were forced to employ was not to be shaken by the fear of punishment or the hope of reward. Yet, by patience and ingenuity, they overcame all obstacles, and executed with great accuracy one of the most important operations, of this nature, ever undertaken. To accomplish this, however, took them nine years; of which three were occupied in determining the latitudes alone.\*

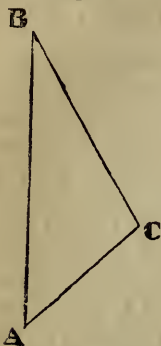
I have recited the foregoing facts, in order to give you some idea of the unwearied pains which astronomers have taken to ascertain the exact figure of the earth. You will find, indeed, that all their efforts are characterised by the same love of accuracy. Years of toilsome watchings, and incredible labour of computation, have been under gone, for the sake of arriving only a few seconds nearer the truth.

The length of a degree of the meridian, as measured in Peru, was less than that before determined in France, and of course less than that of Lapland; so that the spheroidal figure of the earth appeared now to be ascertained by actual measurement. Still, these measures were too few in number, and covered too small a portion of the whole quadrant from the equator to the pole, to enable astronomers to ascertain the exact law of curvature of the meridian, and therefore similar measurements have since been prosecuted with great zeal by different nations, particularly by the French and English. In 1764, two English mathematicians of considerable eminence, Mason and Dixon, undertook the measurement of an arc in Pennsylvania, extending more than one hundred miles.

\* "Library of Useful Knowledge:" History of Astronomy, page 25.

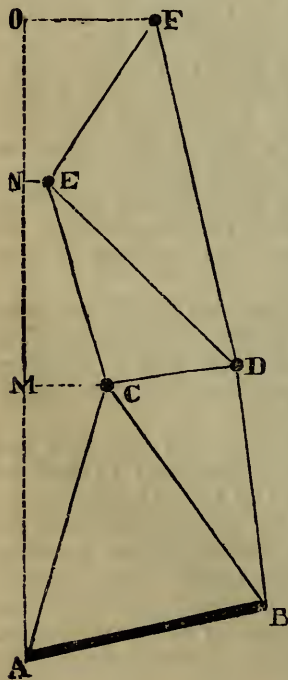
These operations were carried on by what is called a system of *triangulation*. Without some knowledge of trigonometry, you will not be able fully to comprehend this process; but, as it is in its nature somewhat curious, and is applied to various other geographical measurements, as well as to the determination of arcs of the meridian, I am desirous that you should understand its general principles. Let us reflect, then,

Fig. 5.



that it must be a matter of the greatest difficulty to execute with exactness the measurement of a line of any great length in one continued direction on the earth's surface. Even if we select a level and open country, more or less inequalities of surface will occur; rivers must be crossed, morasses must be traversed, thickets must be penetrated, and innumerable other obstacles must be surmounted; and finally, every time we apply an artificial measure, as a rod, for example, we obtain a result not absolutely perfect. Each error may indeed be very small, but small errors, often repeated, may produce a formidable aggregate. Now, one unacquainted with trigonometry, can easily understand the fact, that, when we know certain parts of a triangle, we can find the other parts by calculation; as, in the rule of three in arithmetic, we can obtain the fourth term of a proportion, from having the first three terms given. Thus, in the triangle A B C, Fig. 5, if we know the side A B, and the angles at A and B, we can find by computation, the other sides, A C and B C, and the remaining angle at C. Suppose, then, that in measuring an arc of the meridian through any country, the line were to pass directly through A B, but the ground was so obstructed between A and B, that we could not possibly carry our measurement through it. We might then measure another line, as A C, which was accessible, and with a compass take the bearing of B from the points A and C, by which means we should learn the value of the angles at A and C. From these data we might calculate, by the rules of trigonometry, the exact

Fig. 6.



length of the line A B. Perhaps the ground might be so situated that we could not reach the point B, by any route; still, if it could be seen from A and C, it would be all we should want. Thus, in conducting a trigonometrical survey of any country, conspicuous signals are placed on elevated points, and the bearings of these are taken from the extremities of a known line, called the base, and thus the relative situation of various places is accurately determined. Were we to undertake to run an exact north and south line through any country, as New England, we should select, near one extremity, a spot of ground favourable for actual measurement, as a level, unobstructed plain; we should provide a measure whose length in feet and inches was determined with the greatest possible precision, and should apply it with the utmost care. We should thus obtain a *base line*. From the extremities of this line, we should take (with some appropriate instrument) the bearing of some signal at a greater or less distance, and thus we should obtain one side and two angles of a triangle, from which we could find, by the rules of trigonometry, either of the unknown sides. Taking this as a new base, we might take the bearing of another signal, still further on our way, and thus proceed to run the required north and south line, without actually measuring anything more than the first, or base line. Thus, in Fig. 6, we wish to measure the distance between the two points A and O, which are both on the same meridian, as is known by their having the same longitude; but, on account of various obstacles, it would be found very inconvenient to measure this line directly,



with a rod or chain, and even if we could do it, we could not by this method obtain nearly so accurate a result, as we could by a series of triangles, where, after the base line was measured, we should have nothing else to measure except angles, which can be determined, by observation, to a greater degree of exactness than lines. We therefore, in the first place, measure the base line, A B, with the utmost precision. Then, taking the bearing of some signal at C from A and B, we obtain the means of calculating the side B C, as has been already explained. Taking B C as a new base, we proceed, in like manner, to determine successively the sides C D, D E, and E F, and also A C, and C E. Although A C is not in the direction of the meridian, but considerably to the east of it, yet it is easy to find the corresponding distance on the meridian, A M; and in the same manner we can find the portions of the meridian M N and N O, corresponding respectively to C E and E F. Adding these several parts of the meridian together, we obtain the length of the arc from A to O, in miles; and by observations on the north star, at each extremity of the arc, namely, at A and at O, we could determine the difference of latitude between these two points. Suppose, for example, that the distance between A and O is exactly five degrees, and that the length of the intervening line is three hundred and forty-seven miles; then, dividing the latter by the former number, we find the length of a degree to be sixty-nine miles and four tenths. To take, however, a few of the results actually obtained, they are as follows:

Places of observation.	Latitude.	Length of a degree in miles.
Peru . . . . .	00° 00' 00"	68·732
Pennsylvania . . . . .	39 12 00	68·896
France . . . . .	46 12 00	69·054
England . . . . .	51 29 54½	69·146
Sweden . . . . .	66 20 10	69·292

This comparison shows, that the length of a degree gradually increases, as we proceed from the equator towards the pole. Combining the results of various estimates, the dimensions of the terrestrial spheroid are found to be as follows:

Equatorial diameter . . . . .	7925·648 miles.
Polar diameter . . . . .	7899·170   ,,
Average diameter . . . . .	7912·409   ,,

The difference between the greatest and the least is about twenty-six and one half miles, which is about one two hundred and ninety-ninth part of the greatest. This fraction is denominated the *ellipticity* of the earth,—being the excess of the equatorial over the polar diameter.

The operations, undertaken for the purpose of determining the figure of the earth, have been conducted with the most refined exactness. At any stage of the process, the length of the last side, as obtained by calculation, may be actually measured in the same manner, as the base from which the series of triangles commenced. When thus measured, it is called the *base of verification*. In some surveys, the base of verification, when taken at a distance of four hundred miles from the starting point, has not differed more than one foot from the same line, as determined by calculation.

Another method of arriving at the exact figure of the earth is by observations with the *pendulum*. If a pendulum, like that of a clock, be suspended, and the number of its vibrations per hour be counted, they will be found to be different in different latitudes. A pendulum that vibrates thirty-six hundred times per hour, at the equator, will vibrate thirty-six hundred and five and two-thirds times, at London, and a still greater number of times nearer the north pole. Now the vibrations of the pendulum are produced by the force of gravity. Hence their comparative number at different places is a measure of the relative forces of gravity at those places. But when we know the relative forces of gravity at different places, we know their relative distances from the centre of the earth; because the nearer a place is to the centre of the earth, the greater is the force of gravity. Suppose, for example, we should count the number of vibrations of a pendulum at the equator, and then carry it to the north pole, and count the number of vibrations made there in the same time,—we should be able, from these two observations, to estimate the relative forces of gravity at these two points;

and, having the relative forces of gravity, we can thence deduce their relative distances from the centre of the earth, and thus obtain the polar and equatorial diameters. Observations of this kind have been taken with the greatest accuracy, in many places on the surface of the earth, at various distances from each other, and they lead to the same conclusions respecting the figure of the earth, as those derived from measuring arcs of the meridian. It is pleasing thus to see a great truth, and one apparently beyond the pale of human investigation, reached by two routes entirely independent of each other. Nor, indeed, are these the only proofs which have been discovered of the spheroidal figure of the earth. In consequence of the accumulation of matter above the equatorial regions of the earth, a body weighs less there than towards the poles, being further removed from the centre of the earth. The same accumulation of matter, by the force of attraction which it exerts, causes slight inequalities in the motions of the moon; and since the amount of these becomes a measure of the force which produces them, astronomers are able, from these inequalities, to calculate the exact quantity of the matter thus accumulated, and hence to determine the figure of the earth. The result is not essentially different from that obtained by the other methods. Finally, the shape of the earth's shadow is altered, by its spheroidal figure,—a circumstance which affects the time and duration of a lunar eclipse. All these different and independent phenomena afford a pleasing example of the harmony of truth. The known effects of the centrifugal force upon a body revolving on its axis, like the earth, lead us to infer that the earth is of a spheroidal figure; but if this be the fact, the pendulum ought to vibrate faster nearer the pole than at the equator, because it would there be nearer the centre of the earth. On trial, such is found to be the case. If, again, there be such an accumulation of matter about the equatorial regions, its effects ought to be visible in the motions of the moon, which it would influence by its gravity; and there, also, its efforts are traced. At length, we apply our measures to the surface of the earth itself, and find the same fact, which had thus been searched out among the hidden things of Nature, here palpably exhibited before our eyes. Finally, on estimating from these different sources, what the exact amount of the compression at the poles must be, all bring out nearly one and the same result. This truth, so harmonious in itself, takes along with it, and establishes, a thousand other truths on which it rests.

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## LETTER IV.

### DIURNAL REVOLUTIONS.

“To some she taught the fabric of the sphere,  
The changeful moon, the circuit of the stars,  
The golden zones of heaven.”—*Akenside*.

WITH the elementary knowledge already acquired, you will now be able to enter with pleasure and profit on the various interesting phenomena dependent on the revolution of the earth on its axis and around the sun. The apparent diurnal revolution of the heavenly bodies, from east to west, is owing to the actual revolution of the earth on its own axis, from west to east. If we conceive of a radius of the earth's equator extended until it meets the concave sphere of the heavens, then, as the earth revolves, the extremity of this line would trace out a curve on the face of the sky; namely, the celestial equator. In curves parallel to this, called the *circles of diurnal revolution*, the heavenly bodies actually *appear* to move, every star having its own peculiar circle. After you have first rendered yourself familiar with the real motion of the earth from west to east, you may then, without danger or misapprehension, adopt the common language, that all the heavenly bodies revolve around the earth once a day, from east to west, in circles parallel to the equator and to each other.

I must remind you that the time occupied by a star, in passing from any point in the meridian until it comes round to the same point again, is called a *sidereal day*, and measures the period of the earth's revolution on its axis. If we watch the returns



of the same star from day to day, we shall find the intervals exactly equal to each other; that is, *the sidereal days are all equal*. Whatever star we select for the observation, the same result will be obtained. The stars, therefore, always keep the same relative position, and have a common movement round the earth,—a consequence that naturally flows from the hypothesis that their *apparent* motion is all produced by a single *real* motion; namely, that of the earth. The sun, moon, and planets, as well as the fixed stars, revolve in like manner; but their returns to the meridian are not, like those of the fixed stars, at exactly equal intervals.



Fig. 7.

itself to all sides of a spherical loadstone. We should dwell on this point until it appears to us as truly up, in the direction B B, C C, D D, when one is at B, C, D, respectively, as in the direction A A, when he is at A, Fig. 7.

Let us now suppose the spectator viewing the diurnal revolutions from several different positions on the earth. On the *equator*, his horizon would pass through both poles; for the horizon cuts the celestial vault at ninety degrees in every direction from the zenith of the spectator; but the pole is likewise ninety degrees from his zenith, when he stands on the equator; and consequently the pole must be in the horizon. Here, also, the celestial equator would coincide with the prime vertical, being a great circle passing through the east and west points. Since all the diurnal circles are parallel to the equator, consequently, they would all, like the equator, be perpendicular to the horizon. Such a view of the heavenly bodies is called a *right sphere*, which may be thus defined: *a right sphere is one in which all the daily revolutions of the stars are in circles perpendicular to the horizon*.

A right sphere is seen only at the equator. Any star situated in the celestial equator would appear to rise directly in the east, at midnight to be in the zenith of the spectator, and to set directly in the west. In proportion as stars are at a greater distance from the equator towards the pole, they describe smaller and smaller circles, until, near the pole, their motion is hardly perceptible.

If the spectator advances one degree from the equator towards the north pole, his horizon reaches one degree beyond the pole of the earth, and cuts the starry sphere one degree below the pole of the heavens, or below the north star, if that be taken as the place of the pole. As he moves onward towards the poles, his horizon continually reaches further and further beyond it, until when he comes to the pole of the earth, and under the pole of the heavens, his horizon reaches on all sides to the equator, and coincides with it. Moreover, since all the circles of daily motion are parallel to the equator, they become, to the spectator at the pole, parallel to the horizon. Or, *a parallel sphere is that in which all the circles of daily motion are parallel to the horizon*.

The *appearances* of the diurnal motions of the heavenly bodies are different in different parts of the earth,—since every place has its own horizon, and different horizons are variously inclined to each other. Nothing in astronomy is more apt to mislead us, than the obstinate habit of considering the horizon as a fixed and immutable plane, and of referring every thing to it. We should contemplate the earth as a huge globe, occupying a small portion of space, and encircled on all sides, at an immense distance, by the starry sphere. We should free our minds from their habitual proneness to consider one part of space as naturally *up* and another *down*, and view ourselves as subject to a force (gravity) which binds us to the earth as truly as though we were fastened to it by some invisible cords or wires, as the needle attaches

To render this view of the heavens familiar, I would advise you to follow in your own mind a number of separate stars, in their diurnal revolution, one near the horizon, one a few degrees above it, and a third near the zenith. To one who stood upon the north pole, the stars of the northern hemisphere would all be perpetually in view when not obscured by clouds, or lost in the sun's light, and none of those of the southern hemisphere would ever be seen. The sun would be constantly above the horizon for six months in the year, and the remaining six continually out of sight. That is, at the north pole, the days and nights are for six months of equal lengths, and at the south similar to those at the north.

A perfect parallel sphere can never be seen, except at one of the poles,—a point which has never been actually reached by man; yet the British discovery ships penetrated within a few degrees of the north pole, and of course enjoyed the view of a sphere nearly parallel.

As the circles of daily motion are parallel to the horizon of the pole, and perpendicular to that of the equator, so at all places between the two the diurnal motions are oblique to the horizon. This aspect of the heavens constitutes an oblique sphere, which is thus defined: *an oblique sphere is that in which the circles of daily motion are oblique to the horizon.*

Suppose, for example, that the spectator is at the latitude of fifty degrees. His horizon reaches fifty degrees beyond the pole of the earth, and gives the same apparent elevation to the pole of the heavens. It cuts the equator and all the circles of daily motion, at an angle of forty degrees,—being always equal to what the altitude of the pole lacks of ninety degrees; that is, it is always equal to the co-altitude of the pole. Thus, let H O, Fig. 8, represent the horizon, E Q the equator, and P P' the axis of the earth. Also, *ll m m*, *nn*, parallels of latitude. Then the horizon of a spectator at Z, in latitude fifty degrees, reaches to fifty degrees beyond the pole; and the angle E C H, which the equator makes with the horizon, is forty degrees,—the complement of the latitude. As we advance still further north, the elevation of the diurnal circle above the horizon grows less and less, and consequently the motions of the heavenly bodies more and more oblique to the horizon, until finally, at the pole, where the latitude is ninety degrees, the angle of elevation of the equator vanishes, and the horizon and the equator coincide with each other, as before stated.

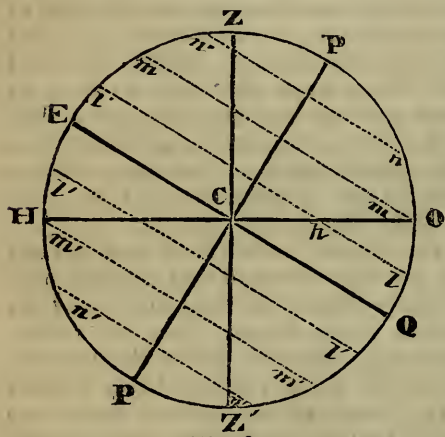


Fig. 8.

*The circle of perpetual apparition is the boundary of that space around the elevated pole, where the stars never set.* Its distance from the pole is equal to the latitude of the place. For, since the altitude of the pole is equal to the latitude, a star, whose polar distance is just equal to the latitude, will, when at its lowest point, only just reach the horizon; and all the stars nearer the pole than this will evidently not descend so far as the horizon. Thus *m m*, Fig. 8, is the circle of perpetual apparition, between which and the north pole, the stars never set, and its distance from the pole, O P, is evidently equal to the elevation of the pole, and of course to the latitude.

In the opposite hemisphere, a similar part of the sphere adjacent to the depressed pole never rises. Hence, *the circle of perpetual occultation is the boundary of that space around the depressed pole, within which the stars never rise.*

Thus, *m' m'*, Fig. 8, is the circle of perpetual occultation, between which and the south pole, the stars never rise.

In an oblique sphere the horizon cuts the circles of daily motion unequally. Towards the elevated pole, more than half the circle is above the horizon, and a greater and greater portion, as the distance from the equator is increased, until finally,



within the circle of perpetual apparition, the whole circle is above the horizon. Just the opposite takes place in the hemisphere next the depressed pole. Accordingly, when the sun is in the equator, as the equator and horizon, like all other great circles of the sphere, bisect each other, the days and nights are equal all over the globe. But when the sun is north of the equator, the days become longer than the nights, but shorter, when the sun is south of the equator. Moreover, the higher the latitude, the greater is the inequality in the lengths of the days and nights. By examining Fig. 8, you will easily see how each of these cases must hold good.

Most of the appearances of the diurnal revolution can be explained, either on the supposition that the celestial sphere actually turns around the earth once in twenty-four hours, or that this motion of the heavens is merely apparent, arising from the revolution of the earth on its axis, in the opposite direction,—a motion of which we are insensible, as we sometimes lose the consciousness of our own motion in a ship or steam-boat, and observe all external objects to be receding from us, with a common motion. Proofs, entirely conclusive and satisfactory, establish the fact, that it is the earth, and not the celestial sphere, that turns; but these proofs are drawn from various sources, and one is not prepared to appreciate their value, or even to understand some of them, until he has made considerable proficiency in the study of astronomy, and become familiar with a great variety of astronomical phenomena. To such a period we will therefore postpone the discussion of the earth's rotation on its axis.

While we retain the same place on the earth, the diurnal revolution occasions no change in our horizon, but our horizon goes round, as well as ourselves. Let us first take our station on the equator, at sunrise; our horizon now passes through both the poles and through the sun, which we are to conceive of as at a great distance from the earth, and therefore as cut, not by the terrestrial, but by the celestial horizon. As the earth turns, the horizon dips more and more below the sun, at the rate of fifteen degrees for every hour; and, as in the case of the polar star, the sun appears to rise at the same rate. In six hours, therefore, it is depressed ninety degrees below the sun, bringing us directly under the sun, which, for our present purpose, we may consider as having all the while maintained the same fixed position in space. The earth continues to turn, and in six hours more, it completely reverses the position of our horizon, so that the western part of the horizon, which at sunrise was diametrically opposite to the sun, now cuts the sun, and soon afterwards it rises above the level of the sun, and the sun sets. During the next twelve hours, the sun continues on the invisible side of the sphere, until the horizon returns to the position from which it set out, and a new day begins.

Let us next contemplate the similar phenomena at the *poles*. Here the horizon, coinciding, as it does, with the equator, would cut the sun through its centre and the sun would appear to revolve along the surface of the sea, one half above and the other half below the horizon. This supposes the sun in its annual revolution to be at one of the equinoxes. When the sun is north of the equator, it revolves continually round in a circle, which, during a single revolution, appears parallel to the equator, and it is constantly day; and when the sun is south of the equator, it is, for the same reason, continual night.

When we have gained a clear idea of the appearances of the diurnal revolutions, as exhibited to a spectator at the equator and at the pole, that is, in a right and in a parallel sphere, there will be little difficulty in imagining how they must be in the intermediate latitudes, which have an oblique sphere.

The appearances of the sun and stars, presented to the inhabitants of different countries, are such as correspond to the sphere in which they live. Thus, in the fervid climates of India, Africa, and South America, the sun mounts up to the highest regions of the heavens, and descends directly downwards, suddenly plunging beneath the horizon. His rays, darting almost vertically upon the heads of the inhabitants, strike with a force unknown to the people of the colder climates; while in places remote from the equator, as in the north of Europe, the sun, in summer, rises very far in the north, takes a long circuit towards the south, and sets as far northward in the

west as the point where it rose on the other side of the meridian. As we go still further north, to the northern parts of Norway and Sweden, for example, to the confines of the frigid zone, the summer's sun just grazes the northern horizon, and at noon appears only twenty-three and one half degrees above the southern. On the other hand, in midwinter, in the north of Europe, as at St. Petersburg, the day dwindles almost to nothing,—lasting only while the sun describes a very short arc in the extreme south. In some parts of Siberia and Iceland, the only day consists of a little glimmering of the sun on the verge of the southern horizon, at noon.

[To be continued.]

ON THE ARTIFICIAL FORMATION OF MINERALS.—To penetrate the hidden processes of Nature, whereby the gems and beautiful crystallized minerals we so frequently meet with imbedded in the cavities of rocks, are produced, has been the aim of many distinguished modern philosophers. But partial success has attended their endeavours, and to my thinking for one very good reason, viz., that when a crystalline mineral is not of igneous origin, but dependent upon aqueous, atmospheric, or molecular action or change, that Time is an essential element in its production; a period compared with which, the life of man is of a verity but “a span long.” By igneous action, various minerals have been synthetically obtained in the hearths of iron furnaces, of porcelain furnaces, and in the flame of the oxyhydrogen blowpipe; the usual condition being, as in the experiments of Edelmann, that the components of the minerals should be held in solution, or at any rate in suspension, by some solvent capable of volatilization of intense heats; qualifications especially possessed by borax and boracic acid. By such means, felspar, ruby, spinelle and many aluminous minerals have been obtained in a crystalline form. Some few may be obtained from their aqueous solutions, as various earthy or metallic carbonates, and others again by weak electrical action. This last natural force is that M. Becquerel has availed himself of, with much success, in his investigations on this subject. His experiments were commenced in 1845, and his results have just been published, from which it appears that he has succeeded in obtaining *crystallized hydrated oxide of zinc*, and also *crystallized protoxide of lead*, by suffering galena (intermixed with blende?) to act on strong and mixed solutions of common salt and sulphate of copper. By this reaction

he has obtained, after the expiration of six to seven years, chloride of sodium in cubes, cubic octohedrons, and octohedrons; chloride of lead in cubic and also in acicular crystals; sulphate of lead in cuneiform octohedrons exactly resembling the Anglesea mineral; chlorosulphate of lead in acicular crystals; oxychloride of lead in very minute crystals, and amorphous sulphuret of copper; all which substances coated the lump of galena, giving it the appearance of a specimen from a natural mineral vein. By weak voltaic arrangements this physicist obtained the carbonate of lime and of lead in a crystalline form. These experiments seem to show that when one substance is slowly oxidized in solutions of others upon which the oxide formed will react, that various insoluble and soluble crystalline bodies result from this action; and also, that when several complicated double decompositions are induced of a very slow and feeble nature, that the result may be the formation of many different insoluble crystalline compounds, precisely similar to those we meet with in many minerals.

COMMERCE tends to wear off those prejudices which maintain distinction and animosity between nations. It softens and polishes the manners of men. It unites them by one of the strongest of all ties, the desire of supplying their mutual wants. It disposes them to peace, by establishing in every state an order of citizens, bound by their interests, to be the guardians of public tranquillity. As soon as the commercial spirit acquires vigour, and begins to gain an ascendant in any society, we discover a new genius in its politics, its alliances, its wars, and its negotiations.





### KING ALFRED ;

#### A TALE OF THE ANGLO-SAXONS.

Still strife, still sorrow. Britain struggling still  
'Gainst outward foes, and much internal ill ;  
Yet sent by Heaven, appears a master-mind—  
Alfred the Great, the just, the good, and kind.

It was the gray of early morning, just the chill and melancholy hour which precedes the visible rising of the sun, and a keen and cutting wind was sweeping over the marshy and moor land, surrounding a few detached huts, scarcely worthy the name of a village, called Athelney.

At the door of one of these lowly dwellings stood two figures, both anxiously looking forth into the gray light, as though endeavouring to distinguish some

beloved or expected form. Both were females ; the eldest, a woman of tall stature and stately presence, whose hair was white with the snows of sixty winters. Her garments, of coarse woollen material, were of common make, but worn with a certain dignity and ease which seemed to express that the mind of the wearer was of no common mould. Her face was very pale and thin, her bright blue eyes restless and tearful, and the clasping and loosening of her folded hands told of the mental tumult which existed within. By her side stood a young girl of not more than sixteen or eighteen summers, a fair and fragile-looking being, seeming at the first glance but ill-fitted to encounter hardships and sorrows ; but the keen observer, on a closer view, would have noted that in the broad high brow, serene eyes, and steadfast look of the maiden, which told of courage, and unwavering and undaunted resolution. Her garb was not only like her companion's, of coarse texture, but was worn and scanty ; and the pale and careworn expression of her



face seemed to tell a tale not only of mental anxiety, but of bodily privation.

"Some evil has happened, Myra," said the elder female; "he was never yet so late,—his rash daring surely has led him into the hands of the Danish wolves."

"Nay, noble Osburga," returned the maiden, "let us not yet despair; the want we have of late suffered, and his ill success in obtaining food yesterday, may have led him to take a wider circuit in quest of it to-day."

"Oh! Alfred, my king, my son," exclaimed Osburga, fervently, "what a fate is this for thee! Yet, outcast as thou now art, Heaven's justice surely slumbers not, and ere long shall thy sword replace thee on thy throne, to be a blessing to this devastated land."

"Hist, lady!" cried Myra, "surely I see forms moving on the brow of yonder hill;—yes, surely, it is he!"

"'T is but a neat-herd, child, driving some cattle," returned her companion, despondingly.

"Nay, gracious lady, it is King Alfred's form and bearing,—I am sure it is he;" and with rapid step the girl hastened to meet the approaching traveller.

Her conjecture proved correct, and, in a few minutes, Alfred, weary and dispirited, crossed the threshold of the hut which formed his shelter and hiding-place. Greeting his mother with mingled reverence and affection, he answered to their sad and inquiring looks.

"Again unsuccessful;—do not weep, my noble mother. I must seek our sustenance to-day in the pools and ditches, and again turn fisherman for us all. I have been, since I left you, within a very little distance of the Danish camp,—would to Heaven I could get within, I might be better able to judge of the chances for me, could I venture another battle."

Myra, who, while he spoke, had been endeavouring to raise a flame on the rude hearth, looked up. As he ceased speaking, a glance of earnest intelligence flitted across her features, but she ventured no remark; and Alfred and his aged parent, over their scanty and coarse repast of oaten bread, exchanged sorrowful retrospections of the past and anticipations of the future. But the mind of the king was by no means destitute of hope, even

under the difficulties of his present circumstances; and, mingling with his manly and noble regret for the trials of the present, were bright dreams of a future day,—when, under his auspices, learning, religion, and refinement, might bless his native land,—when commerce might arise, and the semi-barbarism and degradation of the long-oppressed country give place to the blessings and the arts of peace.

With deep solicitude he questioned whether any of his little band of followers, who had been driven with him into Athelney, had been heard of during his absence on the previous day. But all had been quiet; and Alfred, grieving for the hardships they must necessarily suffer, pined still more for the ability to aid them by an active resistance to their common foes.

The eyes of Myra glistened as she stood silently listening to the converse of the royal pair, and the desire to aid the plans of her sovereign arose in her mind. To her thought of personal danger never occurred,—or, if it did, was banished as of no moment, in comparison with the stake at issue; and she resolved to make the hazardous attempt to penetrate to the Danish camp, and obtain some information of the movements and forces of the enemy. But, knowing that if her intention was communicated to Alfred it would be at once frustrated, she remained silent, and throwing a cloak upon her shoulders, and muffling her head and features in a hood, she prepared to leave the hut.

"Whither now, fair Myra?" inquired the king.

"I must seek a fresh supply of firewood ere the day be far spent," she replied, "and the present hour is the best and safest."

"Poor Myra," rejoined Alfred, kindly, "we are strangely circumstanced that thou, a noble's daughter, and my royal mother's best beloved friend, shouldst have to stoop to such menial offices. Nay, stay child, do not go,—remain with my mother, I will seek what thou needest."

The tears rose to Myra's eyes, and an almost irrepressible emotion rendered her voice tremulous, as, kneeling at Alfred's feet, she kissed the hand he had extended to raise her; and, briefly combating his



arguments, turned and vanished from the cottage.

\* \* \* \* \*

There were light and revelry in the Danish camp,—the beams of the setting sun being replaced by the glare of torches, which shed a lurid light over the scene. Here and there were scattered groups of half-clad half-armed warriors, fierce and repulsive in their appearance, carousing merrily, and chanting wild and barbarous lays. In the centre of the encampment was a tent of larger dimensions than the rest; from its top floated the Danish banner, bearing the Raven,—their national emblem, and believed by them to possess magical properties. Around the tent were assembled a number of the chieftains of the party,—some of whom were conversing gravely, others joining in the noise and revelry around. Suddenly a group of armed men crossed the encampment, and approached the tent;—as they did so, one of the loungers accosted the leader.

"Well, bold Oswin, what success hast thou had? How many kine have fallen tribute to thee? Whom hast thou there? A captive! and, by the ring of Odin, a fair one,—let us see her, brave Oswin."

"Hold, Eric," replied Oswin, sternly, "touch not my captive, I must take her before Guthrun, it may be she may know somewhat of this English king who has as yet escaped us. Give way, I say!" and, pushing through a group whom curiosity had drawn together, the Dane hastily entered the tent with his fair prisoner.

It was a large but rude chamber (if a space of ground curtained only from the sky, and possessing no furniture or decoration, save a rough table, a bench, and a variety of warlike implements, could be so called); at the table stood a group of men, grim and stern-featured, to the tallest and sternest of whom, Oswin at once, and without ceremony, presented his young prize.

"Who is this, Oswin?"

"A stray maiden whom we stumbled on to-day, noble Guthrun," was the reply; "her language is not that of the boors of this place. Is it not possible she may know somewhat of the British king?"

"True, valiant Oswin," said the chief, bending a look of mingled sternness and interest on the trembling girl before him;

"who art thou, maiden?—what art thou called?"

"I am called Myra, noble sir," replied the captive; "I am poor and helpless, and was but gathering wood for fuel, when these rude men seized me,—I beseech you let me return to my mother, who will weep my absence."

"Softly, my fair one, we let not such birds escape when once caught. Leave her here, noble Oswin, I will question her further anon."

"Nay," said the Dane, "I leave her not here, Guthrun, she is my lawful prize, and I will venture her in no man's charge,—question her as thou wilt, but she departs hence with me."

The face of the chief grew white with passion, and for a moment he grasped the handle of a huge battle-axe which lay beside him; but a glance at Oswin seemed to alter his purpose, and, relinquishing the weapon, he drew him aside, and urged upon him, as it seemed, other and more pacific inducements to forego his claim. These were long resisted; but at last apparently successful, for Myra's captor departed, leaving her with the stern and ferocious group,—amongst whom she beheld no face which beamed with pity, not one to whom in her terror she could look for counsel or aid.

They questioned her of her residence, occupation, and of the current rumours respecting Alfred; and, even amid her fear, she possessed the courage to give evasive answers; so that the Danes became at length convinced of her ignorance on the all-important subject, and one by one left the tent,—until at last Guthrun alone remained with his captive, whose heart beat painfully as he approached, and taking her hand he led her to a bench, and seating himself beside her, gazed long and earnestly upon her.

"Thou fearest me, maiden?" he asked, after a long pause.

"I do," she replied, frankly; "but I beseech thee, noble Guthrun, harm me not! I will serve thee as a vassal, truly and faithfully,—but spare me,—oh! spare me."

"Listen," said the Dane. "Years ago, I had a daughter, as young and comely as thyself; and, when we first planted our banner in this land, some of thy people

captured her. They showed no mercy to *her*, and she soon died,—say, shall I not have revenge?”

Myra answered not, but taking a dagger from the ground offered the weapon to the Dane, and, kneeling before him, lifted an imploring and yet fearless look to his face.

“Take my life, then,” she said, “and let my blood be an offering to your revenge!—I fear not death.”

“Nor shalt thou meet either death or dishonour here, Myra,” replied the chief, raising her,—“I saved thee from Oswin’s power, and will not harm thee; but free thou wilt never more be. Rest content—my daughter, not my slave!”

\* \* \* \* \*

Days passed away, and still the mirth and revelry went on in the Danish camp; but grave looks began to be worn by the elder chieftains, and serious consultations were held in the tent of Guthrun, where Myra was still an attentive but unnoticed listener. Much she heard that she would have forfeited life itself to have been able to have conveyed to Alfred, but escape was impossible; and anxiously she saw the days go by, and felt that her adventure had been useless to him whom she had perilled so much to serve. One occupation served to render her captivity less tedious, this was the communication of the principles of Christianity to her heathen master; and the harsh and sombre features of the Dane would relax and soften, as the sweet voice of his adopted child pleaded the pure and gracious precepts of her own religion, as opposed to the ignorant and blood-stained worship of the heathen Odin.

\* \* \* \* \*

The noon-day banquet was just ended, and the wine-cup circulated freely among those who crowded the tent of Guthrun, and song and jest arose,—when the attention of Myra, who sat at her master’s feet, was attracted by the entrance of a minstrel, who, harp in hand, entered the tent, and, bowing lowly, commenced a wild and martial song. The harper appeared to be an old and feeble man, but something in his voice struck Myra so forcibly that she with difficulty restrained an exclamation of surprise and joy. His song was received with acclamations by the revellers, and hour after hour passed

away in the enjoyment of listening to his music. When night closed, Guthrun himself invited his further stay, and permitted him to sleep beneath the outer tent,—an inner tent or division being appropriated to the chief and his own household. When the night had fallen, and all around her lay hushed in repose, Myra stealthily arose, and with noiseless step sought the couch of the minstrel. The moonbeams fell through the opening of the tent on the hard resting-place assigned him, and showed her, too, that he was awake, and listening.

“My lord Alfred,” she whispered,—“O! why hast thou ventured here?”

“Why art *thou* here, Myra?” returned the disguised monarch. “We mourned thee as lost, and lost indeed I fear thou art.”

With rapid words, Myra related the purpose she had had in view in approaching the Danish encampment, her adventures, and finally her success in ascertaining much of vital import to Alfred’s interests.

“A battle has been fought, my lord,” said Myra,—“two Danish chiefs, Hubba and Biom Ironside, have been encountered by the men of Wessex, defeated, and slain. Their magic banner, the Raven, has fallen into the hands of our people,—and the Danes here are dispirited and weakened by superstitious fears. All this I have learned, and am assured of; and thankful am I that I am permitted to tell it to your ears.”

“My lion-hearted girl,” said Alfred, warmly, “this indeed is news worth even such a venture as thou hast made, and will decide my future course. But here thou must not stay, Myra,—return with me?”

“Nay,” interrupted the maiden, “I am watched and guarded,—I dare not venture an escape. Depart thou, my lord, as quickly as may be; and I will pray in my captivity for thy success, and may be soon *my* deliverance also.”

For three days the supposed minstrel lingered in the Danish camp, gaining much information of their numbers and proposed movements; but on the fourth day, when called for to amuse the assembled warriors, he was not to be found. His departure excited neither suspicion or



suprise, the visits of the wandering gleemen (as they were termed), being of common occurrence, even in the camp of an invading enemy.

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Weeks sped onward, and still no fresh movement took place in the Danish army under Guthrun. Entrenchments were thrown up, and provision made to secure the safety of their present position, but the news from without was still of evil import to them, and Myra's heart beat with renewed hope as she beheld the evident perplexity and failure of courage among the enemies of her country. But if the Danes were inactive, not so King Alfred. Summoning his followers, they entrenched themselves at Athelney, and providing there for the safety of their families, and being joined by the men of Somerset, their bold and active leader at length marched against the invaders. Pausing on the verge of the great forest of Selwood, he unfurled his banner, and from every surrounding quarter his subjects flocked and gathered beneath it. The tidings of Alfred's approach reached the Danish chief, and, assembling his army, he prepared to march against Alfred, but ere his plans of operation were well matured, the lances of the Anglo-Saxon warriors appeared on an opposite eminence, and a battle was inevitable.

On Myra's heart the din and preparation of battle fell with strange power, and a longing desire for freedom now possessed her, with the desire to remove her suspense and anxiety by being a witness of the eventful struggle. On his departure Guthrun had commanded her to be strictly guarded, but in the excitement and turmoil which reigned in the Danish camp, she contrived at length to escape unobserved, and, under shelter of the night, to reach the threatening armies. She beheld the outstretched line of her fellow countrymen, stern and eager to save their land from a foreign yoke,—she beheld, on the morn of battle, Alfred, her king, the one for whom she had perilled more than life and for whom her heart beat with reverence and love inexpressible, advance to the front of his troops, and evidently address them in powerful and exciting language. He ceased, and from their ranks rose a deep

and solemn cry,—the cry for liberty or death!

There was a moment's silence, a movement in both armies—and then a shower of arrows fell upon the Danes, and the first shriek of death resounded. The English and British lances were next hurled against their adversaries, and then the armies closing were engaged hand to hand. Long and murderous was the conflict, the plain was strewn with the dying and the dead, Anglo-Saxon, Briton, and Dane, lay mingled on the red and trampled sward. The plain was intersected with low bushes, and two or three half-ruined huts stood upon its verge, and from the shelter of one of the latter Myra watched the chances of the day. Yet upon the king alone was her interest centred; she beheld him, first in the battle, setting an example of unflinching courage to his followers; she saw the threatening battle-axe above his head, the spear at his breast, and could have shrieked in her terror, but the blow was evaded or parried, and again she breathed. At length she beheld a tall and powerful Dane in combat with Alfred, who eagerly defending himself, by degrees was driven from the ranks of his own army, and left alone; the Dane pressed on him, several joined in the attack, and Myra, with feelings amounting to agony, beheld her sovereign driven towards her hiding-place, and apparently sinking beneath accumulated blows. Suddenly, a fresh opponent attacked him, the gigantic Dane poised and raised his heavy two-handed sword. The blow descended, not on its intended victim, but on the head of Myra, who, sinking at his feet, poured out her heart's blood for her king, and lifted her expiring eyes to the face of Guthrun, her horror-stricken and unintentional murderer.

\* \* \* \* \*

Ere the day closed the English were masters of the field, and the Danes were driven within their entrenchments. Closely blockaded by Alfred's army, dispirited, and ere many days starving—the Northmen at length submitted, and negotiated a peace with their conqueror. Alfred, wise and prudent in his successes, as patient in his adversities, saw the policy of investing his conquered foes, with some subordinate power, and Northumbria,

Mercia, East Anglia, and a portion of Essex were ceded to them, as tributary vassals to the English king. On Guthrun the tragical death of Myra produced a deep and lasting impression. The stern warrior mourned the death of his adopted daughter with silent but ceaseless remorse, and shortly after assuming the reins of his new government became a professed convert to Christianity, many of his subjects likewise embracing that religion. For a time peace hovered again over England. Alfred, the just, wise, and great, struggled earnestly to advance his country in all the peaceful attainments of science and literature, and while defending his harassed country from the incursions of predatory invaders, laid many a foundation for future triumphs of learning, wisdom, and law, and under the auspices of this, the greatest of the Anglo-Saxon monarchs, the seeds of future blessings were sown, never to be rooted out, or utterly destroyed. To this admirable law-giver we owe many of our most valuable and time-honoured institutions, and principles of liberty and justice, which endear the name of Alfred to every British heart.

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**CANDIDATE.**—It was the custom, while the Roman republic subsisted in full vigour, for the candidates for high offices to appear on the day of election in long white robes, intimating by this that their characters likewise ought to be pure and unsullied. Hence the origin of our word candidate, from *candidus*, white, pure, sincere, upright, &c. In the Roman commonwealth, we are told, they were obliged to wear a white gown, during the two years of their soliciting for a place. This garment, according to Plutarch, they wore without any other clothes, that the people might not suspect they concealed money for purchasing votes; and also, that they might the more easily show to the people the scars of those wounds they had received in fighting for the defence of the commonwealth. It was also unlawful to put up for any public office, or magistracy, unless the candidate had attained to a certain age, which differed according to the offices sued for.

## THE MIRROR OF NATURE,

(Continued from page 21.)

It needed not this assurance to fill the mind of Duval with thoughts of his end; he felt himself at the point of death, and the benumbing of his senses, which, from time to time, crept over him, appeared to him already the beginning of the death-slumber, which, in his half dreams, he saw approaching without dismay or fear. But the miracle of divine Providence, which alone, as the farmer had said, could save him, had already begun. He had found just at the right moment this healing covering, and a sort of instinct had suggested to the farmer this mode of taking from the disease its fatal power, a mode, singular indeed and most offensive to the senses, but at the same time most serviceable in the present instance. The warm breathing of the sheep that lay around his grave, the warmth which his grave itself diffused all over him, excited a salutary perspiration; and mitigated the virulence of the disease. The violent headache and the stupor were removed; to the eye of another, his situation was loathsome to look at, but to the boy himself it was quite tolerable.

While Duval thus lay buried in the sheep-stall, and had nothing to complain of but extreme weakness and a gradually returning appetite, the winter raged without with ever increasing violence. Several times at night he was awakened by a noise like thunder or a discharge of artillery, and when he inquired of the farmer, in the morning, the cause of this nightly alarm, he told him that the frost had split one or more of the walnut or oak trees that stood near, from the root up, or that by the freezing of the moisture in the crevices of the rocks, the rocks had exploded as if by gunpowder. Without, on the roads as in the hovels, men daily froze to death. The farmer himself in his poor dwelling could scarcely, by the flaming hearth, keep himself from freezing; while Duval was as comfortable in his strange situation, and among his brutish attendants, as the king or a prince of France, in his well guarded room.

Nevertheless, this good fortune was not wholly uninterrupted, for in the midst of his comfortable feeling of repose and the



moderate warming of his feeble limbs, as the disease abated, the plague of hunger set in. The shepherd who had taken on himself, according to his ability, the charge of the boy, was a very poor man. The exorbitant taxes which the rich king of France had imposed on his poor subjects, had taken from the farmer almost all his household utensils, his cattle, and the things indispensable to the culture of his fields. The sheep alone remained, because they were not his, but belonged to the proprietor of the estate. The good man did, however, what he could. He gave his poor patient twice every day a thin water broth, which had no condiment but salt, and even this so sparingly that it was scarcely to be tasted, for even salt was taxed so heavily that poor people could hardly supply this want. A corked bottle was the vessel in which the oat-broth was brought—the only way in which it could be kept from freezing—the boy keeping the bottle close to him in his warm bed, and taking a draught from time to time. The water which was brought to him was frequently half frozen.

For some weeks this food sufficed to allay hunger, but soon the increasing strength of the boy demanded more nutritious diet. But the poor farmer could afford nothing but a watery soup and some pieces of black bread, which were frozen so hard that they had to be cut with an axe, and only the warmth of the mouth or of the bed made them eatable. As trifling as these gifts of a love, which received not its reward on earth, may have been in the eyes of men, they soon exceeded nevertheless the ability of the poor farmer, who saw himself compelled to apply to the clergyman of the village for help for his patient. His application found a hearing. The abode of the pastor was almost a league distant from the sheep-fold. Thither Duval was carried after being taken from his grave, wrapt in rags and hay, and seated upon an ass. The cold was still so severe, and the change so great, that he arrived at his new shelter half dead, and with every limb stiff. To prevent the injurious effects of the frost, his body was rubbed with snow, and he was placed in a situation which, in its character and fitness to create a moderate warmth, was as well adapted to him as that from which he had been taken

in the sheep-fold. Only after a week, when the cold had considerably decreased, was the patient, again becoming strong, carried to a chamber and laid in an ordinary bed. The care and food which he received in the parsonage, were indeed much better than the poor shepherd had been able to afford him. Duval soon felt himself as well and as strong as he had been before his sickness. With the return of health came also the inclination to wander. The good pastor could employ no additional servant in his little household. He intimated to the now vigorous lad that he should look about him for employment, gave him a little travelling money, and dismissed him from his kindly care with his affectionate blessing.

Just at that period there was the greatest difficulty in finding employment in Champagne. There would indeed have been a demand every where for labourers; for the reckless, violent levying of recruits for the army among the youth and men had taken from the herds their keepers and from the land its tillers. But, as useful as the labour of a robust young man would have been, it could not be taken advantage of: every master of a family, where any such were, had trouble not only in securing bread for himself and his dependents,—he could share the little yet to be obtained with no new comer. As we have already said, the extraordinarily severe winter had annihilated almost all hopes of a harvest for this year either for the farmer or the vine-dresser. The collectors of the taxes, the forestallers of grain, who refused to sell in hopes of yet higher prices, asked not about the distress of the poor people, they were almost as hard-hearted as their king, Louis XIV. Like him, they thought only of satisfying their greed, even though thousands perished, and the suckling died at the breast of its starving mother.

Jameray Duval, as he thus, without finding employment, went from village to village, and from farmyard to farmyard, and everywhere saw nothing but bitter want, and heard of nothing but scarcity, dearth, and starvation, asked at last whether there were not any other country where the grain was not frozen. He was told that, perhaps, towards the East and the South, there might be regions which the warmer influence of the sun had pro-

tected against the devastations of the winter. This intimation filled the heart of the young wanderer with joy and hope. In his apprehension the world appeared, as it seems on a serene day to the inhabitants of a plain, to be a dish-shaped expanded surface, upon whose rim the crystal concave of the sky rests, over which the sun passes by day, while the stars are lighted like lamps at night, to be extinguished in the morning. The sun itself, as it is represented in the almanac like a human head, the boy held to be a living being of fire, of which it seemed to him altogether probable that it must give the most warmth where it was nearest to the earth, and that was in the eastern horizon, at its rising. Resting in this belief, our Valentine now directed his course to the quarter where the sun rose. The commencement of his journey did not appear fitted to animate him to its continuance; it led him through the poorest parts of Champagne. The low, clay-built huts, covered with reeds or straw, with their inmates clad in rags, whose withered countenances, pallid with want and trouble, seemed, like the wasted features of their half-naked children, capable of no glad smiles, but only of weeping, were well adapted to appal his love of wandering. In addition to these things, there was the want of the most ordinary means of subsistence, a want shared alike by the vagrant and the inhabitant of the land. Instead of what might properly be called bread, a baked composition of crushed hemp-seed appeased the hunger of the people. Duval had need to be thankful, if he could only procure enough of this unwholesome food to allay his appetite. But the benefit was only apparent; he acquired no strength, but a disagreeable sensation in the head was produced by this diet, of which he was not free for years afterwards. All this, however, could not obstruct the career upon which he had entered; impelled by a mighty inward impulse, he pursued his way, with all possible speed, towards the East. Travelling in this direction, he came one day to the top of a hill, at whose foot lay a not very attractive looking district (Bourbonne les Bains). A thick vapour, which rose from its midst, appeared to the young wanderer to be the smoke of a conflagration just being extinguished. He was not a little

astonished when he was told that it came from the hot springs, which there rise out of the earth. Such an unexpected piece of information excited his curiosity in a high degree. He ran to the springs, laid himself down on the ground, put his hand several times into the bubbling water, but had to withdraw it quickly, as the heat was too great to be borne. Thereupon, in childish ignorance, he pursued his further inquiries. Nowhere was a stove or fireplace to be seen, which might make the water boil so. "What," he thought, "could any one suppose but that this was the neighbourhood of hell? and only great levity could have thought of building and dwelling on such a spot."

From this supposed vicinity of hell, our young wanderer came the next morning upon a landscape which, by its blooming appearance, reminded him of the neighbourhood of heaven. The annoyances and troublesome inquiries, which now obstruct the traveller as he passes from one little country to another, were then unknown. Duval had, without knowing it, passed the boundaries of oppressed exhausted France, and had come into Lorraine, which at that time was still under the mild government of its German princes. What a difference was there already between the first village of Lorraine, Senaide, and those parts of Champagne through which his direct route from west to east had led him! Here were no longer to be seen those poor, low, rush-covered clay huts, with their pale, wasted inmates, but high and well-walled houses, roofed with tiles, and occupied by beings whose well-fed persons and fresh complexions spoke of ease and comfort. How merry, round-cheeked and beautiful, were the well-clothed children, in comparison with the children of the French borders, half-naked, and pining away in dirt and misery.

It was Sunday; the sound of bells called the people to public worship in the well-built spacious church; even Duval, thankfully glad as he had hardly ever before been, hastened thither. Here everything that he saw seemed new and beautiful; the armorial double eagle over the door of the vestibule, the dress of the people, so grand in his eyes, the multitude of young men, whom no tyrannical force tore from their homes and families, to be sacrificed to the



insatiable ambition of an oppressive king. Instead of the poor frocks of coarse ticking and sackcloth, which his countrymen wore, our young wanderer saw the men of Senaide clad in becoming clothes, with silver buttons, and the women with short sleeves and ruffles, as richly dressed as the best ladies of the cities of Champagne. Here the clatter of the heavy wooden shoes was unheard, in which the country people of Champagne put their bare feet, for even the poorest were provided with shoes and stockings. And not only the eager eyes but the famished stomach of the stranger found food here. Instead of the nauseous hempseed bread, there was sweet wheaten bread, with meat and other articles of food, all which the liberality of the villagers offered for almost nothing. It was good to be here, so Duval thought; here was the land to which the warming sun was nearer at its rising than to the rest of the earth; here he wished to remain. And the wish was gratified. The people were able to employ and support labourers. The shepherd of the near village of Clezantaine took the robust active boy into his service.

Two years long Duval tended the sheep on the hills of Clezantaine, and was comfortably supported. He was now sixteen years old, and tall and strong for his age. That inward force which had led him hither, as the bird is led by instinct, began to stir anew; but not in a mere animal way, impelling him to seek the stilling of his hunger and a place of bodily well-being, but in a human spiritual way, and on this account he was moved all the more powerfully. This impulse, which left the youth no rest, aimed at other satisfactions, was directed to a higher repose than the physical world could furnish. It was directed to the unfolding, not of the outward, but of the inward spiritual man. Our herdsboy felt that something was wanting, but what he knew not. When alone in the fields he saw the trees and flowers, the beasts and stones; when the moon stood, now in the evening sky, as a sickle or growing disk, and showed him his way home, and now again, in its waning, when it brightened the morning hours, then he fell into deep thought about all these things, and the changes they underwent, till he could find no beginning

and no end. Where the little brook, which flowed by the village, had its beginning he knew, for in summer he visited its fountain almost daily, but whence the water came, that always rose out of the earth, he could not ascertain; and that the brooks united in rivers, then into bays, and then ran into the sea,—this he knew from hearsay, but he would gladly see and know it with his own eyes. When the neighbours sometimes came together at the herdsman's, or when, on Sundays and holidays, the villagers, and, perhaps, a stranger among them, fell into talk before the church, he listened with the utmost attention to all they said about war and peace, of events taking place here and there, of other lands and places. He had ever to ask, wished always to learn more; but what these good people told him only stimulated instead of appeasing his curiosity. From the height on which Duval often tended his sheep, a landscape was to be seen, among the most fruitful that comprehended Lorraine, green meadows and fields, amidst which lay a multitude of little farms, extended as far as the eye reached, from the north toward the south, to the foot of the blue mountains of the Vosges, which bounded the prospect to the east. There, on those blue mountains, Duval longed to stand and see what lay beyond, for this much he had learned, that the world was much greater and more extensive than the circle of his vision.

That which had been sometime before only a pleasure to his eyes, now became the joy and desire of his heart. Duval could no longer resist the impulse which urged him to quit his present place. He parted from his employer, and once more resumed his wandering towards the east. There, at the foot of the Vosges, not far from Deneuvre, a pious hermit, brother Palemon, had, about that time, his hermitage, called by the country people by the name of La Rochette. A more delightful abode for a solitary, who wished to live with his thoughts on God, far from the noise and disquiet of the world, could hardly be found. From the top of the rock on which the hermitage stood, one could see the sun descend behind a green undulating plain, through which wound a river, which floated the ship timber, bound

in long rafts, down to the sea-coast. On the opposite (the eastern) side, the beams of the setting luminary fell upon the slope of mountains divided by beautiful valleys and ravines, and adorned up to their tops with fine villages and country seats. With the fragrance of blossoming trees and shrubs, the tones of the nightingale rose to the wanderer seated on the rock. Duval could not quit the spot; at least one night and the next morning he resolved to spend in this place, he begged the hermit to give him a resting-place in his hut, and his request was granted.

It was that all-considering Providence, which brings together what belongs together at the right time and place, that had directed Duval's steps to the hermitage of La Rochette. Brother Palemon had need of just such a young useful assistant, who could help him in his garden, and in various other things. The true-hearted lad, whom God himself had led to him, pleased him well, and nothing could please Duval more than to enter into the service of brother Palemon.

We have said already that Jameray, when the great poverty of his mother compelled him to quit the village school and go into service as a keeper of poultry, had barely learned to read. This art, obviously one of the most important among all the arts which man can make his own, was, and always continued to be, highly valued by him. He had impatiently waited for an opportunity to practise it. But such opportunities had hitherto been very few. What of readable matter was to be found in the house of his former master, the shepherd, consisted only of an almanac and a mass-book. The lively curiosity of the boy found therein little nourishment. But here, in brother Palemon's dwelling, there was a whole library of books never before seen, which numbered more than twelve volumes. Besides one or two parts of a then popular work, which bore the name of the "Blue Library," the literary food of the pious hermit consisted only of such works as contained directions to a contemplative life, prayers and meditations, lives of saints, and accounts of monks and hermits.

(To be continued.)

## HISTORY OF BOOK-KEEPING

BOOK-KEEPING may be defined that systematic arrangement of commercial transactions, by which the true state of the proprietor's concerns may be easily ascertained; thus, at once exhibiting correct and ready information of every particular in trade, and the general result of the whole, in point of profit or loss. It cannot be necessary in an age so distinguished as the present for commerce, to speak of the importance of this science; but perhaps a brief sketch as an attempt to trace its origin and progressive improvements, may not be displeasing to the reader; in which the subject must be understood to imply the method by *double entry*, usually called the *Italian*; for it is obvious that some system of recording money affairs, under the heads of receipts and disbursements, must have been practised in the very infancy of commerce.

Like most other valuable sciences, the date of its origin is extremely uncertain, but the earliest trace that can be found of it is about the beginning of the fifteenth century,\* when it was practised at Venice, at that time remarkable as the emporium of commerce; and hence this method is usually called the *Italian*, because (as is generally supposed) we are indebted to that nation for our knowledge in the art.

Some of those authors who are always zealous champions for the ancients, and will hardly allow any meritorious improvement in science due to the moderns, have contended that *double entry* was known by the Romans, and merely revived in Italy with returning commerce; in support of this hypothesis, they have exercised much critical ingenuity and erudition; and have quoted several passages from the classics, proving that the ancients commonly entered the receipts and payments of money upon opposite sides after the way of debtor and creditor; of such instances the following passage from Pliny (book ii. chap. 7.) may serve for a specimen, as, indeed, it seems extremely in favour of their argument.

"Huic (*scil.* fortunæ) omnia expensa;

\* Vide "Beckman's Inventions and Discoveries;" also "Stevens's Book-keeping applied to Finance."



huic omnia feruntur accepta; et in tota ratione mortalium sola utramque paginam facit."

But even admitting the ancients *did* arrange their accounts in the debtor and creditor method, still this implies no more than *single entry*; commerce was then in a very rude and imperfect state, and consequently it is extremely probable that nothing more was requisite: but the most weighty objection to this opinion is, that the ancient languages afford *no terms correspondent to the modern, technical phrases of double entry*; and Snellius, when he translated "Steven's Book-keeping" into Latin, after the most scrupulous research for such terms in vain, was compelled to *coin* them; thus he called the art itself, *Apologistica*: the Waste Book, *Liber Deletitiis*; the Ledger, *Codex accepti expensique*; Stock, *Sors*; Balance, *Epilogismus*, &c.

Indeed the terms adopted in most of the European languages, appear to be derived immediately from the *Italian*, with the exception of the English word *Ledger*, which has exhibited as much variation in the orthography, as it has occasioned disputes about its etymology;—it was formerly spelt *Leager*, *Leadger*, *Leidger*, *Leiger*, *Leger*, and lastly *Ledger*—its name in the Italian and southern languages of Europe, implies the master book; in the German and other northern provinces, the head book, and in the Dutch and French, the grand book;—as to its derivation, Bailey refers it to the Latin verb, *legere*, to gather: but Dr. Johnson says, it is from the Dutch *leggen*, to continue in one place; while some others again have conjectured it arose from the *liege* books of the feudal ages, which recorded the rents, duties, and services due from liege men (or tenants).

Having thus advanced the arguments *pro* and *con*, as to the claims of the *ancients* to a knowledge of this art, I proceed to submit some conjectures in favour of the *moderns*; perhaps it is not at all improbable that the principle of double entry was suggested by the double purpose of bills of exchange, and the ordinary way of entering them; these we know are decidedly a modern invention, or it might possibly have been deduced from some of Euclid's axioms, or by the operations of algebraic equations; in support of the last

opinion, the following circumstance is remarkably apposite:—

Lucas de Borgo, an Italian friar, was the first who translated Algebra from the Arabic into any of the European languages—he was one of the earliest writers on several other mathematical subjects, and is generally supposed to have composed the first express treatise on this science; it was published in his native language (the Italian) in 1495, which is nearly the most distant period to which we can with certainty trace back the origin of Book-keeping; and thus much for the claims of the *moderns* to this invention—let the reader settle the point in dispute.

Assuming then the prior part of the fifteenth century (as has been already remarked) to be the origin of this science, I now endeavour to follow its progress in this country: and although the southern parts of Europe were acquainted with Book-keeping by the Italian manner at the above-mentioned period, it appears that the knowledge was diffused but slowly; for we find nothing of it in England till 1543, when the first English work on this subject was published at London, by Hugh Oldcastle, a school-master, which was much improved, and reprinted by John Mellis (also a school-master) in 1588, the curious reader may find some account of this work in "Aymes's Antiquities of Typography," where a copy of the title is thus given:—"A brieve instructione and maner howe to kepe bookes of accomptes partible, &c., by three bookes, named y<sup>e</sup> memoriall, jorhall, and leager.—Newley augmented and sette forth by John Mellis, schole maister of London:—imprynted by hime at y<sup>e</sup> signe of y<sup>e</sup> White Beare, nighe Baynard's Castel, 1588."

The *next* treatise of which we have any account was by James Peele, and this was also published in London, in 1569: in his preface, he says, "though long practised in foreign parts, this art was but then *new* in England!"

This work was succeeded in 1652 by a considerably improved system in a large treatise by John Collins, a very celebrated mathematician, whose publication served as a standard book nearly a century.

These were the principal early English writers on this art, during the first two centuries since its introduction to this

country; which again received much improvement, in a well-known popular work, published 1736, by John Mais, a professor of mathematics at Perth: from this period numerous were the authors upon this subject, but they followed each other so closely, both in manner and matter, that very little benefit arose from their productions; to give a list would be tedious, but the most approved of them are Dodson, Donn, Dowling, Dilworth, Crosby, Cooke, Hamilton, Hatton, London, Miers, Malcolm, Stevens, Snell, Webster, Wood, &c. whose treatises all appeared from 1720 to 1770.

Hitherto the writers upon Book-keeping were all teachers, and although as such, they were competent to explain the principles, they had not the means of practically proving their theories; and, consequently their works were but an indifferent preparative for the counting-house; this defect was supplied in 1789, by a judicious and elaborate work by Benjamin Booth, a merchant, whose treatise has enabled later authors to combine the theory, and elementary precepts of the instructor, with the improvements resulting from actual mercantile experience; so that in modern works the former has gone hand in hand with the latter.

Before concluding the subject, it may not be amiss to mention the prospectus of a plan published in 1796, to rival the Italian mode, called "The English Book-keeping," by a Mr. Jones; who, therein, boldly represented "the Italian system as delusive and erroneous," and announced his own as an *infallible* plan by *single* entry.

Under the sanction of some eminent names as recommenders, subscriptions at a guinea each were raised to the enormous sum of nearly seven thousand pounds!

Public impatience was very great for the appearance of the work, which was somehow delayed much beyond the appointed time, and many considered the whole as a hoax; at last, however, it came forth, and completely disappointed public expectation. Several pamphlets attacking Mr. Jones's book appeared, and produced others as warm in its defence; thus causing some controversy between the partizans of the old and new systems; at length, a gentleman of the name of Mill gained the triumph of the Italian over the English

mode, and formed a due comparison of their respective claims, by arranging the whole of Mr. Jones's work into a Journal and Ledger by double entry, and in so doing, detected a most important error; consequently the new system fell into merited oblivion; yet, notwithstanding all its defects, it contained several useful hints, and moreover, produced much benefit by causing some valuable discussions on the subject.

## BARON VON HUMBOLDT.

FREDERICK HENRY ALEXANDER VON HUMBOLDT was born at Berlin, Prussia, on the 14th of September, 1769. He was educated at Gottingen and Frankfort-on-the Oder. In 1790 he visited Holland and England; and during the same year published his first work, entitled, "Observations on the Basalts of the Rhine." He went to Freyburg in 1791, to receive instruction in botany and mining from the celebrated Werner.

During the following year he was appointed assessor in the mining and smelting department. Soon afterward he received the appointment of overseer of the mines in Franconia. Here he introduced a variety of improvements. But in 1795 he resigned his office, to gratify an insatiable desire to travel. During this year he visited Italy and Switzerland.

In 1797 Humboldt went to Paris, where he formed an acquaintance with M. Aimé Bonpland, who afterward became his associate traveller. From Paris the Baron set out for Madrid, with a good collection of instruments; for he had for several years cherished the design of travelling within the tropics at his own expense.

In 1799 the court of Spain granted him permission to travel through the Spanish colonies in America. He immediately sent for his young friend Bonpland, who lost no time in joining him, and they set sail from Corunna, for America.

The plan of travel which these two friends sketched for themselves was laid out upon a more extensive scale than that of any journey before undertaken by private persons. Five years was the period in which they proposed to explore distant



regions, and in that space of time, probably no two individuals ever collected so much useful information, and returned home so richly laden with oblations destined for the altar of science.

They took home with them, on their return in 1804, an herbarium containing more than 6,000 species of plants. The preparation of the observations made during this tour, and the publication of works relating to it, occupied the time of these travellers for several years after their return home. The various works relating to this journey comprised seventeen folio and eleven quarto volumes, well illustrated.

The results of this expedition have been of the highest importance to science. In natural history, especially, these observations of six years exceed anything that have been presented by the most successful investigators of this field during a whole lifetime. His valuable works on the subject of plants alone form an era in the history of botany.

In October, 1818, Humboldt visited London. For several years afterwards he was a resident of Paris, and there devoted himself to the sciences.

During the winter of 1822, the king of Prussia called Humboldt to accompany him on a journey through Italy. While residing at Naples, his attention was directed to inquiries concerning the formation of volcanoes; the result of which he gave to the public in a small essay. On finishing this tour he again returned to Paris, where he remained till the latter part of 1826, when he went to Berlin, and delivered a course of lectures on the physical constitution of the globe, which was attended by the court and royal family.

He next undertook an important journey through Northern Asia, as far as the borders of China. In this he was assisted by the Russian government, which wished to obtain, through him, more correct information respecting the character and contents of the Ural mountains. On his return he published an account of his researches in those regions.

In 1845 he published the first volume of the "Cosmos," and completed it in 1847. This is a valuable contribution to physical science. Another work by him, entitled "Views of Nature; or, Contemplations on

the Sublime Phenomena of Creation," has recently been published in London.

Baron Von Humboldt's renown has extended over all parts of the civilized world; and, at the present day, there is not a man of science in Europe whose name is more familiar. And this eminent philosopher is still living, having attained an age of more than fourscore years. Well may he be called the patriarch of modern science.

At the present time he is the friend and companion of the king of Prussia. Though his form is meagre with age, and his head whitened by the snows of eighty winters, the vigour of his intellect remains strong. The following sketch will show how he is said to employ his time:

"His time is systematically divided. He rises at six o'clock in winter, and five in the summer. He studies two hours, then takes a cup of coffee, with a light breakfast, returns to his room, and commences the task of answering his letters, of which he receives, yearly, more than one hundred thousand.

"From twelve o'clock until two he receives visits, and returns to work again at two. At four he dines, usually with the king in summer, and at home in winter. From four o'clock in the afternoon until eleven he passes in dining. Frequently he dines at meetings of learned societies, or in company of his friends.

"At eleven he retires to his study, and continues there until one or two, writing his works, or preparing them by study. His best books have all been written at midnight. He spends only four hours in sleep."

Such are the habits of Baron Von Humboldt; one who is at once an astronomer, a physician, a botanist, a metaphysician, an antiquarian, and a philologist; and one who is learned in statistics and political economy.

This assemblage of acquirements, so rarely found united in a single individual, are in him accompanied with sleepless activity of mind, and all the zeal, enterprise, and vigour necessary to give them their full effect. Long after his career shall have terminated, he will be remembered as one of the chief ornaments of his age.

PRIDE costs us more than hunger, thirst, and cold.

## SCHOOL BOOKS.

WE cannot overrate the importance of First Books for Children. Yet, if we glance through our juvenile literature we find an enormous amount of absolute trash distributed among the rising generation. Old cuts, old types, old fables, and alarming stories of Tommy and Harry, with ill-drawn pictures of the former giving the latter good advice, and the latter being torn to pieces by a lion, for not listening thereto,—these present the too common features of the most popular books for children. In some of the modern works an attempt has been made to supersede the old books by a remarkable cheapness; but this has been gained at the sacrifice of everything like *method* in the arrangement and construction of the lessons, and thus the interest of the child has been sacrificed for the sake of gaining sudden popularity. In a picture book for teaching the alphabet, which has lately come under our notice, the following absurdities and errors occur, amid many others of similar character:—

- "I is an infant, and dressed out in silk."  
 "L is a ladder, for climbing a wall."  
 "R stands for rabbits, for Fanny or John!"  
 "S stands for snail, with its house on its back."  
 "V is a violet, which here you may see."  
 "Y is a youth, who has many kind friends," &c.

In another work, which in many respects is nicely got up, an attempt is made to impart a knowledge of the letters of the alphabet, by employing similitudes, of which we quote a few examples:—

- "S is a snake that is twirling about."  
 "L's a bird's leg, with his toe standing out."  
 "M's like a swing between the two trees."  
 "R's a long flag, blown about by the breeze."  
 "X is just like two crossed pieces of wood."  
 "Z is a toy you shall have if you're good."  
 "J's like the hook with which they catch fish."  
 "V's the nice knife for which you would wish," &c.

That such works are unfitted for the young, on account of these stupid errors, which, once impressed upon the mind, cannot be easily effaced, is sufficiently evident.

An important contribution to National Education has been made through the production of a series of *Illustrated Two-penny School Books*,\* which are destined

to supersede all others of the class. The First Book of Spelling and Reading opens with an—

## ADDRESS TO PARENTS AND TEACHERS.

"The subject of Popular Education very properly excites considerable attention at this time. And, as the result of this excitement, various books have been offered to the public as contributions to the desired end. Some works have appeared with considerable parade, and have, for the sake of sudden popularity, hacked the elements of education in a manner little calculated to promote the diffusion of the latter, or to exalt the character of the press as the organ of the national mind. Convinced that one of the most material aids to popular improvement may emanate from the production of a really excellent series of Elementary Books, at the lowest possible price, we have addressed ourselves to this object, and the 'ILLUSTRATED TWO-PENNY SCHOOL BOOKS' are the result. These Books are designed equally for use in Nurseries and in Schools. An inspection of them will show that they have been written with considerable care, and that many new features and improvements have been introduced. The Series is intended to consist of—

1. FIRST SPELLING AND READING.
2. SECOND SPELLING AND READING.
3. GRAMMAR.
4. WRITING AND COMPOSITION.
5. ARITHMETIC.
6. GEOGRAPHY.

(Forming the First Vol., price 1s. 6d.)

7. ENGLISH HISTORY.
8. NATURAL HISTORY.
9. ASTRONOMY.
10. DRAWING.
11. PHYSICAL TRAINING.
12. MORAL CULTURE.

(Forming the Second Vol., price 1s. 6d.)

The whole of the Series comprising the First Volume will appear almost simultaneously.

"Upon the arrangement of this our First Spelling and Reading Book, considerable care has been bestowed. It will be found to contain One Hundred and Twenty-Seven carefully graduated Lessons in Spelling, and Twenty-five Reading Lessons, illus-

\* London: Houlston and Stoneman.



trated by Twenty-five instructive Engravings.

It will be seen that we have discarded the usual attraction of these first books—a Pictorial Alphabet, in which letters and figures are intermixed, to the production of obscurity in the former. The remarks of an experienced Teacher, in the first volume of *The Family Friend*, first called our attention to this subject. The writer we have alluded to says:—"There should be set before the children a single letter, in bold, hard, outline. There should be no heavy, black lines contrasting hair-drawn ones; no flourishes; nothing but



such a plain form as a young child could not mistake—nothing but a bare skeleton outline." The same lady advises that teachers should form letters of bits of laths and tape laid upon a table, or the floor, and that the children should be taught to



QUAIL.

imitate them. Of the evil of pictorial letters we have been sufficiently convinced

by examining an old and standard work, and also a modern one, which has been received with a large amount of favour, when its demerits, which are very numerous, are taken into account. From the former we copy the Q for Quail, and from the other the letter U. It is true that by the side of each a small and plain letter is given. But all who know the habits of children will at once understand how much their attention must be diverted by these pictures from the precise form to be imprinted upon their minds.

Upon teaching children the alphabet it offers some capital

#### "SUGGESTIONS TO TEACHERS.

A common mode of teaching a child the letters of the alphabet has been to point them all out in succession, until they were remembered by the child in their consecutive order. This is a slow and unsatisfactory method. The impression of each letter on the mind is erased by that which is shown next. A better way is to call the child's attention to only one or two letters at a lesson, give their sounds very distinctly, speak about their appearance, and let him look at them until he can distinguish them, and call their sounds or names. The following plan will be found to be quite original, and its results will afford the greatest satisfaction. Cut out the large letters from this book, and, putting them a little distance off, send the child to fetch A, or N, or W, as you may determine. After a little while you may proceed to amuse and instruct the child by putting the letters down upon objects, of the names of which the letters form the initials. Thus: put T on the Table, and say—

"The T is on something that's spelt with a T;  
Look about, look about, and bring it to me."

The child will be amused to seek and find the letter, and will learn to distinguish not only the letter T, but to understand that the piece of furniture from which he took the letter is called a Table, and that its name begins with a T.

This simple couplet will serve to rhyme with the letters B, C, D, E, G, P, and V; and the letters may be placed variously upon the Bed, a Board, a Basket; a Chair, a Cup, a Cradle; a Door, a Dresser, a Drugget, a Desk, Dimity; an Ear, an

Egg or Egg-cup ; a Glove, a Glass, Gauze, Gooseberry ; a Pitcher, a Poker, a Plum, a Pie or Pie-dish, a Pudding, a Penny, Paper, &c. ; a Vine-leaf, a Vegetable, Velvet, a Vase, &c. &c. When anything nice turns up, as a prize, it will prove a reward.

The book then supplies other couplets for all the remaining letters of the alphabet.

At the head and foot of every page are rhymes and maxims sufficiently simple to impress the mind of the learner :

"Who strives to spell will do so well."  
 "Good boys make no loud noise."  
 "Thank God that he gave life to me."  
 "I love my papa and my mama."  
 "I will be good, 'tis right I should."  
 "Be kind to all, both great and small."  
 "Why should I hurt a poor fly?" &c.

Each twopenny book contains thirty-two pages of letter-press, containing carefully graduated lessons in Spelling and Reading, illustrated by about seventy or eighty appropriate pictures !

The Second Book of Spelling and Reading is a perfect gem in its way. The Reading Lessons are beautifully simple and impressive, including "The Good Child and the Swing," "A Kiss for a Blow," "The Dangerous Companion," "The Watch-key," "The Bird's-nest," "Charles Clear," "The Clouds in the Sky," "Mary's First Sum," "Grandfather Whitehead and the Children," "I Can't," "Keep your Temper," "How my Envy Punished me," "Apprentice Boys," "The Echo," "Began, but not Finished," "Politeness in Children," "Little Children Love one another," &c. It also contains a dial for teaching children to understand the time by the clock, with moveable gilt hands ; and about one hundred lessons in spelling, with simple poems, pictures of animals, &c. &c. All this for Twopence ! Surely education should now be universal. The Reading Lessons are so simple and pretty, that we must quote one or two of them :—

#### "A KISS FOR A BLOW.

"One day a minister went into an infant-school. He had been there before.

"'Please to tell us,' said a little boy, 'what is meant by *overcoming evil with good*?' The minister began to explain it,

when a little incident occurred which gave him a striking illustration.

"A boy, about seven years of age, was sitting beside his little sister, who was only six years old. As the minister was talking, George, for that was the boy's name, got angry with his sister about something, doubled up his fist, and struck her on the head.

"The little girl was just going to strike him back again, when the teacher seeing it, said, 'My dear Mary, you had better kiss your brother. See how angry and unhappy he looks!'

"Mary looked at her brother. He looked sullen and wretched. She threw both her arms about his neck and kissed him.

"The poor boy was wholly unprepared for such a kind return for his blow. His feelings were touched, and he burst out crying.

"His gentle sister took the corner of her apron and wiped away his tears, and sought to comfort him by saying, with endearing sweetness and generous affection, 'Don't cry, George ; you did not hurt me much.' But he only wept the more.

"But why did George weep? Poor little fellow ! Would he have wept if his sister had struck him as he had struck her? Not he. But by kissing him as she did, she made him feel more acutely than if she had beaten him black and blue.

"Here was a *kiss for a blow*, love for anger, and all the school saw at once what was meant by '*overcoming evil with good*.'

#### "THE ECHO.

"One day little George happened to cry out in the fields, 'Ho ! ho !' and he instantly heard the same words repeated from the neighbouring thicket near him.

"Surprised at the sound, he exclaimed, 'Who are you?' upon which the same voice also returned, 'Who are you?'

"George cried out, 'You must be a very foolish fellow.' 'Foolish fellow !' repeated the voice from the thicket. George then began to grow angry, and he uttered words of defiance toward the spot from whence the sound proceeded.

"The echo faithfully repeated all his words. He then ran home, and complained to his Father and Mother that a



wicked boy was concealed in the wood for the purpose of mocking him.

"Ah, now, you are complaining of your own self," replied his father, who then read to him from a book about the Echo, and afterwards said: 'Know that you have heard nothing but your own words; for even as you have seen your face reflected in the clear water, so you have just heard your own voice in the woods.'

"If you had uttered an exclamation of kindness, you would have received the same in reply.'

"It is thus in every-day life. *The conduct of others towards us is generally an echo of our own.*"

POETICAL READING LESSON.—THE BIRD'S NEST.

"To-WHIT! to-whit! to-whoee!  
Will you listen to me?  
Who stole four eggs I laid,  
And the nice nest I made?"

"Bob-a-link! Bob-a-link!  
Now what do you think?  
Who stole my nest away  
From the plum-tree to-day?"

"Not I," said the cow; "moo-oo!  
Such a thing I never would do.  
I gave you a wisp of hay,  
But I did not take your nest away."

"Not I," said the dog; "bow-wow!  
I would not be so mean, I vow!  
I gave the hairs the nest to make,  
But the nest I did not take."

"Not I," said the sheep, "O no!  
I would not treat a poor bird so.  
I gave the wool, the nest to line;  
But the nest was none of mine."

"Caw! caw!" cried the crow;  
"I should very much like to know  
What thief stole away  
A bird's nest to-day."

"Cluck! cluck!" said the hen;  
"Do not ask me again.  
Why, I have not a chick  
That would do such a trick."

"We all gave her a feather,  
And she wove them together.  
I would scorn to intrude  
On her and her brood.  
Cluck! cluck!" said the hen;  
"Do not ask me again."

"Chirr-a-whirr! chirr-a-whirr!  
We will make a great stir.  
Let us find out his name,  
And all cry, 'For shame!'"

"I would not rob a bird,"  
Said little Mary Green,  
"I think I never heard  
Of any thing so mean."

"It is very cruel, too,"  
Said little Alice Neal.

"I wonder if he knew  
How bad the bird would feel?"

A little boy hung down his head,  
And went and hid behind the bed;  
For he stole that pretty nest  
From the poor little Yellow-breast;  
And he felt so full of shame,  
*He did not like to tell his name.*

The other contents are equally as good as the selections we have made. We have no doubt whatever that these very cheap and excellent books will be widely adopted in families and schools; and we have no hesitation in recommending them.

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EXERCISE IN THE COUNTRY.—Walking is good; not stepping from shop to shop, or from neighbour to neighbour, but stretching out far into the country to the freshest fields, and highest ridges, and quietest lanes. However sullen the imagination may have been among its griefs at home, here it cheers and smiles. However listless the limbs may have been when sustaining a too heavy heart, here they are braced, and the lagging gait becomes buoyant again. However perverse the memory may have been in presenting all that was agonizing, and insisting only on what cannot be retrieved, here it is first disregarded, and then it sleeps; and the sleep of the memory is the day in Paradise to the unhappy. The mere breathing of the cool wind on the face in the commonest highways is rest and comfort, which must be felt at such times to be believed. It is disbelieved in the shortest intervals between its seasons of enjoyment; and every time the sufferer has resolutions to go forth to meet it, it penetrates to the very heart in glad surprise.

## FLOWERS.

In observing the many flowers with which nature is so profusely ornamented, we perceive an analogy between them, which leads us to arrange them into classes. This we do in reference to some peculiar natural mark or characteristic. Thus all rose-like flowers we combine together, and this constitutes the natural family Rosacea, embracing the true Floral Queen, the Rose, sung by poets, immortalized by sculptors, and admired by all, since the date of its existence.

Persia is the native land of the rose, where it is extensively cultivated for the purpose of making the celebrated perfume, the Attar or Otto of Roses. The Persians have a curious fable concerning the origin of the rose.

A beautiful maiden had been unjustly condemned to the stake, by the machinations of a wicked man. As the pile was lighted, the flames gathered together in one fierce mass, struck her prosecutor, and blasted him on the spot; while the stake to which she was bound, budded and blossomed with red and white roses, as if to attest the maiden's innocence.

Besides the genus *Rosa*, this family includes those plants having a corolla with five roundish petals, with short claws, and with numerous stamens inserted on the calyx, embracing the apple, peach, plum, quince, etc., together with the raspberry and strawberry. This family contains most of our finest fruits, and is remarkable for including very few poisonous plants.

The natural family Liliaceæ is very beautiful, embracing the lily in its splendid varieties, the magnificent tulip, the queenly iris, the crown-imperial, and the dog-tooth violet, a beautiful wild flower. This family is characterized by having six petals spreading in such a manner as to give the flower a bell-form appearance, three or six stamens, the germ triangular, with three cells, and the root bulbous.

The lily is a splendid flower, and well worthy of being associated with the rose, as it frequently is, and it was selected by the great Teacher to prove the universal care of the Father, "Yet I say unto you, Solomon in all his glory was not arrayed like one of these." The symbolical lan-

guage of the white lily is "Purity," and no one who has seen this delicate flower will doubt the appropriateness of this language.

It was the tulip which created so much excitement among the Dutch florists several years ago. "About the middle of the seventeenth century, the rage for tulips was so great that some were sold for four thousand dollars, and one variety, called the Viceroy, for ten thousand; but this extraordinary traffic was checked by a law, that no tulip or other flower should be sold for a sum exceeding one hundred and seventy-five dollars." The rage for Dahlias for a few years past, though very great, has not been quite so extravagant as this.

The Umbelliferous family presents a striking uniformity of arrangement. The flower stalks are of such a length, and spread out in such a manner as to give the plant the appearance of an umbrella. They have five stamens, the corolla five petalled and minute, and the leaves usually pinnate.

Among the plants of this class used for food are the carrot, parsnep, celery, etc. Umbelliferous plants growing on high ground are highly aromatic and medicinal, as the dill, fennel, caraway, and coriander, while those growing in wet places are among our most deadly poisons.

The *cicuta virosa*, or cowbane, grows in marshy places, and often proves destructive to cows who feed upon it in the spring, before its fetid odour warns them to avoid it. The poison hemlock (*conium maculatum*) has a very unpleasant smell, and a spotted stalk; and like the water parsnep is a violent poison. This is supposed to be the poison which proved so fatal to Socrates. Plants of this description should be avoided, and the rule for determining their nature is very simple and safe.

The Cruciform family is very remarkable in many respects. This has six stamens, four longer than the other two; four petals arranged in the form of a cross; the seeds in a pod; the flowers usually white or yellow, rarely ever purple. To this family belong many of our garden vegetables, as the cabbage, turnip, radish, mustard, etc.

Plants of this family are valuable in



medicine, being anti-scorbutic in all their varieties. They are *never* poisonous, and on chemical analysis are found to contain sulphur, and are characterized by a biting, pungent taste.

The Labiate family contains a large number of interesting plants, many of them highly medicinal. Every one is familiar with the properties of many of this class, such as the catnip, horehound, pennyroyal, etc.

This family is distinguished by having *four stamens, two of which are longer than the others*, and a labiate corolla, either personate or ringent. They usually inhabit hillsides and places exposed to the sun; and if highly aromatic their medicinal properties are stimulating; if bitter, they act as a tonic.

There are two divisions of this class; the ringent, which contains the peppermint, horehound, lavender, thyme, the scull-cap (said to be a remedy for hydrophobia), the marjoram savory, etc. Plants of this kind usually grow in whorls at the angles of the stem, and are *never* poisonous.

The second division includes the *personate* flowers, or those with close lips. They are much more beautiful than the former division, including the splendid trumpet flower, the foxglove, etc. They differ from the others not only in beauty, but in not being used like many of them in preparing food, for they are generally very poisonous, though some of them possess powerful medicinal properties.

Sis Walter Scott says :

“Foxglove and nightshade, side by side,  
Emblems of punishment and pride”—

thus associating the beautiful foxglove with the deadly and disagreeable nightshade. But it is with plants as with persons: beauty is no symbol of usefulness, and we frequently find the most splendid appearing of both, corrupt and dangerous, and we instinctively turn from them to the more useful flower, or the virtuous individual.

**SANCTITY.**—Despise not a profession of holiness—because it may be true; but have a care how you trust it—for fear it should prove false.

**MUSIC OF BIRDS**—It is not in towns, amid the discordant sounds of artificial life, that the simple denizens of air can be listened to with advantage. The outskirts of a country village in a campaign country, where trees and copses are numerous, but not dense (for song-birds affect neither the wood nor the wild), is the place where these companions of the spring are truly at home; and he who would most exquisitely enjoy their untaught warblings, must wake when they wake. In the heat of noon-tide, when the insect tribe are on the wing, the birds are too busy in procuring subsistence to attend to play. Then it is that the call of business is imperative, in the country as in the town; and the merry lark chants not to the idle, but to the industrious. The morning is the time for enjoying the song of birds; and he who would hear it in perfection, must not grudge to watch for it the livelong night. It is only in this way that the first starting note of the joyous concert, as well as its dying fall, can be heard. The nightingale is said to sing her amorous descant all night long; but there are not a few that go far to rival her in this respect. The thrush will often be heard after twilight has far advanced; and later in the season, the song of the robin echoes round the cottage, when, from the dim decaying light, the body of the warbler can no longer be seen. Most of the other song-birds cease their notes when the disk of the sun sinks behind the western hills. About half-past nine the thrush begins to nod on the bough (we speak of those latitudes to which Philomel comes not), the only sound that strikes the ear from the time that she has ceased to charm it, is the cry of the land-rail. It is wonderful how brief is the interruption to the not unpleasing “craik” of this singular bird. We have heard it until within a quarter of twelve, and it sounded again by half-past twelve. This was in a part of the island where, in the middle of June, there is twilight even at the noon of night. By one o’clock, or a very little after, there may be distinguished a few faint twitters at intervals. These are the gathering-call of the lark, At first it does not soar as it sings; the sound is as it were the dream of its day-song. By two, it springs from the dewy daisy

which had bent under its breast, to greet the sun from the gates of Heaven. For some time the early chorister is unaccompanied. Gradually, however, as it rises, the light increases; the cold blue streak in the far north-east begins to change to red; the breath of morn blows cool; the ruddy glow shoots upward; at length the golden rim of the glorious sun touches the horizon; and in an instant, as if roused by an electric shock, one universal matin-hymn bursts from every tree and bush, as far round as the ear can drink in the notes. The change from the solitary voicing of the lark to the universal chorus, in which

"The linnet, chaffinch, bulfinch, goldfinch, greenfinch,  
And all the finches of the grove,"

as *Tilburina* has it, bear their part, is exquisitely pleasing. For it may be noticed, that how various soever may be the notes of singing-birds, they all harmonize; there is infinite diversity of tone and of tune, but there is no discord. This universal burst of song continues for about a quarter of an hour, and then the silence becomes almost as perfect as it was before it was broken by the appearance of the sun. The little people having offered up their morning thanks, disperse in search of food; and though the parts of the chorus are taken up by numerous detached pipes in the course of the day, the whole is not rehearsed until another sun has once more given the signal. To those who would investigate the songs of particular birds, the evening is the best time; for as the calm hour approaches, they one by one drop into silence, and their several excellencies may be the more easily appreciated. But if our readers, who have now the liberty which the charge of catering for their amusement denies to ourselves, of rambling over the fields, would hear the whole, they must do as we have been pointing out—watch a summer night for that purpose.

IN 1416, lanterns were first hung out at night in the city of London for the convenience and safety of the citizens; and in 1467 Holborn was first paved.

### CURIOUS DESCRIPTION OF MAN.

The following poetical description of the uses of the different parts of the human body we have quoted from the works of the celebrated Francis Quarles, preserving the obsolete spelling:—

"MAN's *body's* like a *house*, his greater *bones*  
Are the main *timber*; and the lesser ones  
Are smaller *splints*: his *ribs* are *laths* daub'd o're  
Plaister'd with *flesh* and *blood*; his *mouth's* the  
door,  
His *throat's* the narrow *entry*, and his *heart*  
Is the great *chamber*, full of curious art;  
His *midriff* is a large *partition-wall*  
'Twixt the great *chamber* and the spacious *hall*;  
His *stomach* is the *kitchen*, where the meat  
Is often but half sod for want of heat:  
His *spleen's* a *vessel* nature doth allot  
To take the *skum* that rises from the pot:  
His *lungs* are like the *bellows*, that respire  
In every *office*, quickning every fire:  
His *nose* the *chimney* is, whereby are vented  
Such *fumes* as with the *bellows* are augmented:  
His *bowels* are the *sink*, whose parts to drain  
All noisom *filth*, and keep the *kitchen* clean:  
His *eyes* are christal *windows*, clear and bright;  
Let in the object and let out the sight.  
And as the *timber* is, or great or small,  
Or strong, or weak, 'tis apt to stand or fall:  
Yet is the likeliest *building* sometimes known  
To fall by obvious chances; overthrown  
Of times by *tempests*, by the full-mouthed *blasts*  
Of *heaven*; sometimes by *fire*; sometimes it wasts  
Through unadvis'd *neglect*: put case the stuff  
Were ruin-proof, by nature strong enough  
To conquer time and age; put case it should  
Nere know an end, alas, our *leases* would;  
What hast thou, then, *proud flesh* and *blood*, to  
boast?  
Thy daies are evil, at best; but few, at most;  
But sad, at merriest; and but weak, at strongest;  
Unsure, at surest; and but short, at longest."

TRANSACTION OF BUSINESS.—In your converse with the world avoid anything like a juggling dexterity. The proper use of dexterity is to prevent your being circumvented by the cunning of others. It should not be aggressive. Concessions and compromises form a large and very important part of our dealings with others. Concessions must generally be looked upon as distinct defeats, and you must expect no gratitude for them. We are far from saying that it may not be wise to make concessions; but this will be done more wisely when you understand the nature of them. In making compromises do not think to gain much by concealing your views and wishes. You are as likely to suffer from its not being known how to please or satisfy you, as from any attempt to overreach you, grounded on a knowledge of your wishes.



# POPULAR ASTRONOMY.

## LETTER V.

### PARALLAX AND REFRACTION.

"Go, wondrous creature, mount where Science guides,  
Go, measure earth, weigh air, and state the tides;  
Instruct the planets in what orbs to run,  
Correct old Time, and regulate the sun."—*Pope.*

I think you must have felt some astonishment, that astronomers are able to calculate the exact distances and magnitudes of the sun, moon, and planets. We should, at the first thought, imagine that such knowledge as this must be beyond the reach of the human faculties, and we might be inclined to suspect that astronomers practise some deception in this matter, for the purpose of exciting the admiration of the unlearned. I will, therefore, in the present Letter, endeavour to give you some clear and correct views respecting the manner in which astronomers acquire this knowledge.

In our boyhood, we all probably adopt the notion that the sky is a real dome of definite surface, in which the heavenly bodies are fixed. When any objects are beyond a certain distance from the eye, we lose all power of distinguishing, by our sight alone, between different distances, and cannot tell whether a given object is one million or a thousand millions of miles off. Although the bodies seen in the sky are in fact at distances extremely various,—some, as the clouds, only a few miles off; others, as the moon, but a few thousand miles; and others, as the fixed stars, innumerable millions of miles from us,—yet, as our eye cannot distinguish these different distances, we acquire the habit of referring all objects beyond a moderate height to one and the same surface, namely, an imaginary spherical surface, denominated the celestial vault. Thus, the various objects represented in the annexed diagram, though differing very much in shape and diameter, would all be *projected* upon the sky alike, and compose a part, indeed, of the imaginary vault itself. The place which each object occupies is determined by lines drawn from the eye of the spectator through the extremities of

the body, to meet the imaginary concave sphere. Thus, to a spectator at O, Fig. 16, the several lines A B, C D, and E F, would all be projected into arches on the face of the sky, and be seen as parts of the sky itself, as represented by the lines A' B', C' D', and E' F'. And were a body actually to move in the several directions indicated by these lines, they would appear to the spectator to describe portions of the celestial vault. Thus, even when moving through the crooked line, from *a* to *b*, a body would appear to be moving along the face of the sky,

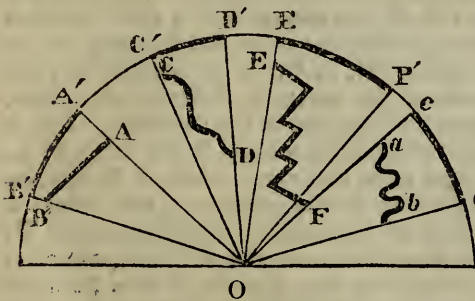


Fig. 16.

and of course in a regular curve line from *c* to *d*.

But, although all objects, beyond a certain moderate height, are projected on the imaginary surface of the sky, yet different spectators will project the same object on *different parts* of the sky. Thus a spectator at A, Fig. 17, would see a body, C, at M, while a spectator at B would see the same body at N. This change of place in a body, as seen from different points, is called *parallax*, which is thus defined: *parallax is the apparent change of place which bodies undergo by being viewed from different points.*

The arc M N is called the *parallactic arc*, and the angle A C B, the *parallactic angle*.

It is plain, from the figure, that near objects are much more affected by parallax

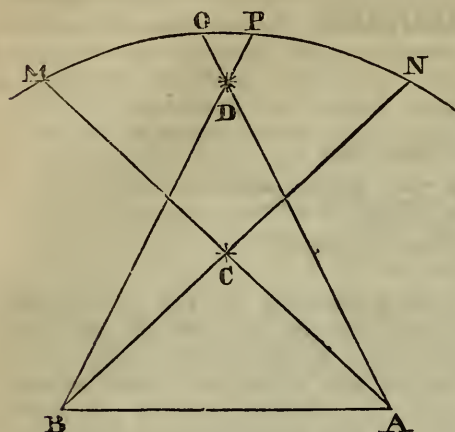


Fig. 17.

something of trigonometry, which science enables us to find certain unknown parts of a triangle from certain other parts which are known. Although you may not be acquainted with the principles of trigonometry, yet you will readily understand, from your knowledge of arithmetic, that from certain things given in a problem others may be found. Every triangle has of course three sides and three angles; and, if we know two of the angles and one of the sides, we can find all the other parts, namely, the remaining angle and the two unknown sides. Thus, in the triangle A B C, Fig. 18,

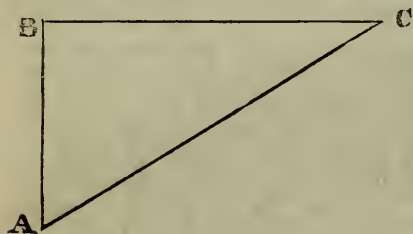


Fig. 18.

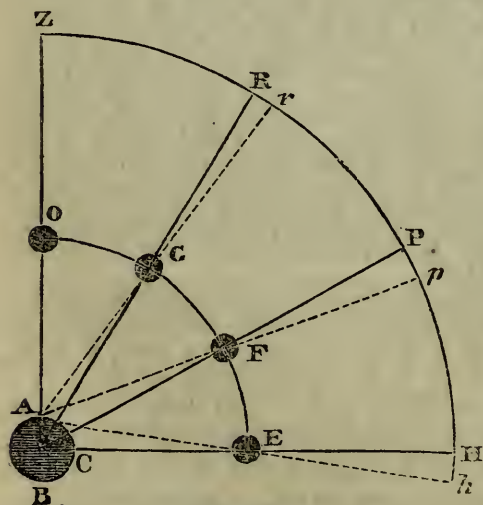


Fig. 19.

than distant ones. Thus, the body C, Fig. 17, makes a much greater parallax than the more distant body D,—the former being measured by the arc M N, and the latter by the arc O P. We may easily imagine bodies to be so distant, that they would appear projected at very nearly the same point of the heavens, when viewed from places very remote from each other. Indeed, the fixed stars, as we shall see more fully hereafter, are so distant that spectators, a hundred millions of miles apart, see each star in one and the same place in the heavens.

It is by means of parallax that astronomers find the distances and magnitudes of the heavenly bodies. In order fully to understand this subject, one requires to know

if we know the length of the side A B, and how many degrees each of the angles A B C and B C A contains, we can find the length of the side B C, or of the side A C, and the remaining angle at A. Now, let us apply these principles to the measurements of some of the heavenly bodies.

In Fig. 19, let A represent the earth, C H the horizon, and H Z a quadrant of a great circle of the heavens, extending from the horizon to the zenith; and let E, F, G, O, be successive positions of the moon, at different elevations, from the horizon to the meridian. Now a spectator on the surface of the earth, at A, would refer the moon, when at E, to *h*, on the face of the sky, whereas, if seen from the centre of the earth, it would appear at H. So, when the moon was at F, a spectator at A would see it at *p*, while, if seen from the centre, it would have appeared at P. The parallactic arcs, H *h*, P *p*, R *r*, grow continually smaller and smaller, as a body is situated higher above the horizon; and when the body is in the zenith, then the parallax vanishes altogether, for at O, the moon would be seen at Z, whether viewed from A or C.

Since, then, a heavenly body is liable to be referred to different points on the celestial vault, when seen from different parts of the earth, and thus some confusion be occasioned in the determination of points



on the celestial sphere, astronomers have agreed to consider the true place of a celestial object to be that where it would appear, if seen from the centre of the earth; and the doctrine of parallax teaches how to reduce observations made at any place on the surface of the earth, to such as they would be, if made from the centre.

When the moon, or any heavenly body, is seen in the horizon, as at E, the change of place is called the horizontal parallax. Thus, the angle A E C measures the horizontal parallax of the moon. Were a spectator to view the earth from the centre of the moon, he would see the semidiameter of the earth under this same angle; hence, *the horizontal parallax of any body is the angle subtended by the semidiameter of the earth, as seen from the body.* Please to remember this fact.

It is evident from the figure, that the effect of parallax upon the place of a celestial body is to *depress* it. Thus, in consequence of parallax, E is depressed by the arc H h; F, by the arc P p; G, by the arc R r; while O sustains no change. Hence, in all calculations respecting the altitude of the sun, moon, or planets, the amount of parallax is to be added: the stars, as we shall see hereafter, have no sensible parallax.

It is now very easy to see how, when the parallax of a body is known, we may find its distance from the centre of the earth. Thus, in the triangle A C E, Fig. 19, the side A C is known, being the semidiameter of the earth; the angle C A E, being a right angle is also known; and the parallactic angle, A E C, is found from observation; and it is a well-known principle of trigonometry, that when we have any two angles of a triangle, we may find the remaining angle by subtracting the sum of these two from one hundred and eighty degrees. Consequently, in the triangle A E C, we know all the angles and on one side, namely, the side A C; hence, we have the means of finding the side C E, which is the distance from the centre of the earth to the centre of the moon.

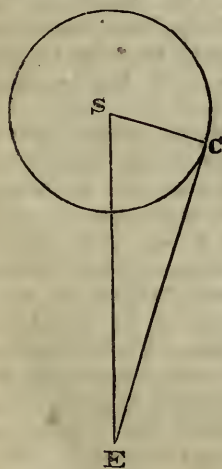


Fig. 20.

When the distance of a heavenly body is known, and we can measure, with instruments, its angular breadth, we can easily determine its *magnitude*. Thus, if we have the distance of the moon, E S, Fig. 20, and half the breadth of its disk S C, (which is measured by the angle S E C,) we can find the length of the line, S C, in miles. Twice this line is the diameter of the body; and when we know the diameter of a sphere, we can, by well-known rules, find the contents of the surface, and its solidity.

You will perhaps be curious to know, *how the moon's horizontal parallax is found*; for it must have been previously ascertained, before we could apply this method to finding the distance of the moon from the earth. Suppose that two astronomers take their stations on the same meridian, but one south of the equator, as at the Cape of Good Hope, and another north of the equator, as at Berlin, in Prussia, which two places lie nearly on the same meridian. The observers would severally refer the moon to different points on the face of the sky,—the southern observer carrying it further north, and the northern observer further south, than its true place as seen from the centre of the earth. This will be plain from

the diagram, Fig. 21. If A and B represent the positions of the spectators, M the moon, and C D an arc of the sky, then it is evident that C D would be the parallactic arc.

These observations furnish materials for calculating, by the aid of trigonometry, the moon's horizontal parallax, and we have before seen how, when we know the parallax of a heavenly body, we can find both its distance from the earth and its magnitude.

Beside the change of place which these heavenly bodies undergo, in consequence of parallax, there is another, of an opposite kind, arising from the effect of the atmosphere, called *refraction*. Refraction elevates the apparent place of a body, while parallax depresses it. It affects alike the most distant as well as nearer bodies.

In order to understand the nature of refraction, we must consider that an object always appears in the direction in which the *last* ray of light comes to the eye. If the

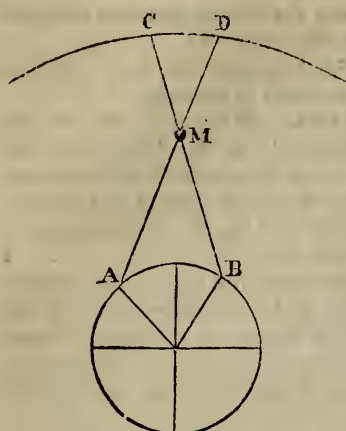


Fig. 21.

medium; and when it passes out of a denser into a rarer medium, as out of water into air, it is turned *from* the perpendicular. In the above case, the light, passing out of space into air, is turned towards the radius of the earth, this being perpendicular to the surface of the atmosphere; and it is turned more and more towards that radius the nearer it approaches to the earth, because the density of the air rapidly increases near the earth.

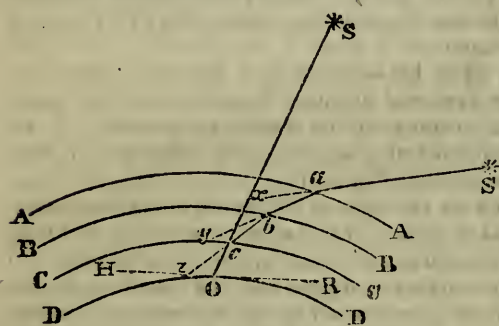


Fig. 22.

O c, and, consequently, the star would apparently change its place, by refraction, from  $S'$  to  $S'$ , being elevated out of its true position. Moreover, since, on account of the continual increase of density in descending through the atmosphere, the light would be continually turned out of its course more and more, it would therefore move, not in the polygon represented in the figure, but in a corresponding curve line, whose curvature is rapidly increased near the surface of the earth.

When a body is in the zenith, since a ray of light from it enters the atmosphere at right angles to the refracting medium, it suffers no refraction. Consequently, the position of the heavenly bodies, when in the zenith, is not changed by refraction, while, near the horizon, where a ray of light strikes the medium very obliquely, and traverses the atmosphere through its densest part, the refraction is greatest. The whole amount of refraction, when a body is in the horizon, is thirty-four minutes; while, at only an elevation of one degree, the refraction is but twenty-four minutes; and at forty-five degrees, it is scarcely a single minute. Hence it is always important to make our observations on the heavenly bodies when they are at as great an elevation as possible above the horizon, being then less affected by refraction than at lower altitudes.

Since the whole amount of refraction near the horizon exceeds thirty-three minutes,

light which comes from a star were bent into fifty directions before it reached the eye, the star would nevertheless appear in the line described by the ray nearest the eye. The operation of this principle is seen when an oar, or any stick, is thrust into water. As the rays of light by which the oar is seen have their direction changed as they pass out of water into air, the apparent direction in which the body is seen is changed in the same degree, giving it a bent appearance,—the part below the water having apparently a different direction from the part above. Thus, in Fig. 22, if  $S$  &  $a$  be the oar,  $S a b$  will be the bent appearance, as affected by refraction. The transparent substance through which any ray of light passes is called a *medium*. It is a general fact in optics, that, when light passes out of a rarer into a denser medium, as out of air into water, or out of space into air, it is turned *towards* a perpendicular to the surface of the

Let us now conceive of the atmosphere as made up of a great number of parallel strata as A A, B B, C C, and D D, increasing rapidly in density (as is known to be the fact) in approaching near to the surface of the earth. Let  $S$  be a star, from which a ray of light,  $S a$ , enters the atmosphere at  $a$ , where, being much turned towards the radius of the convex surface, it would change its direction into the line  $a b$ , and again into  $b c$ , and  $c O$ , reaching the eye at  $O$ . Now, since an object always appears in the direction in which the light finally strikes the eye, the star would be seen in the direction



and the diameters of the sun and moon are severally less than this, these luminaries are in view both before they have actually risen and after they have set.

The rapid increase of refraction near the horizon is strikingly evinced by the *oval* figure which the sun assumes when near the horizon, and which is seen to the greatest advantage when light clouds enable us to view the solar disk. Were all parts of the sun equally raised by refraction, there would be no change of figure; but, since the lower side is more refracted than the upper, the effect is to shorten the vertical diameter, and thus to give the disk an oval form. This effect is particularly remarkable when the sun, at his rising or setting, is observed from the top of a mountain, or at an elevation near the seashore; for in such situations, the rays of light make a greater angle than ordinary with a perpendicular to the refracting medium, and the amount of refraction is proportionally greater. In some cases of this kind, the shortening of the vertical diameter of the sun has been observed to amount to six minutes, or about one-fifth of the whole.

The apparent enlargement of the sun and moon, when near the horizon, arises from an optical illusion. These bodies, in fact, are not seen under so great an angle when in the horizon as when on the meridian, for they are nearer to us in the latter case than in the former. The distance of the sun, indeed, is so great, that it makes very little difference in his apparent diameter whether he is viewed in the horizon or on the meridian; but with the moon, the case is otherwise; its angular diameter, when measured with instruments, is perceptibly larger when at its culmination, or highest elevation above the horizon. Why, then, do the sun and moon appear so much larger when near the horizon? It is owing to a habit of the mind, by which we judge of the magnitudes of distant objects, not merely by the angle they subtend at the eye, but also by our impressions respecting their distance, allowing, under a given angle, a greater magnitude as we imagine the distance of a body to be greater. Now, on account of the numerous objects usually in sight between us and the sun, when he is near the horizon, he appears much further removed from us than when on the meridian; and we unconsciously assign to him a proportionally greater magnitude. If we view the sun, in the two positions, through a smoked glass, no such difference of size is observed; for here no objects are seen but the sun himself.

*Twilight* is another phenomenon depending on the agency of the earth's atmosphere. It is that illumination of the sky which takes place just before sunrise, and which continues after sunset. It is owing partly to refraction, and partly to reflection, but mostly to the latter. While the sun is within eighteen degrees of the horizon, before it rises or after it sets, some portion of its light is conveyed to us, by means of numerous reflections from the atmosphere. At the equator, where the circles of daily motion are perpendicular to the horizon, the sun descends through eighteen degrees in an hour and twelve minutes. The light of day, therefore, declines rapidly, and as rapidly advances after daybreak in the morning. At the pole, a constant twilight is enjoyed while the sun is within eighteen degrees of the horizon, occupying nearly two-thirds of the half year when the direct light of the sun is withdrawn, so that the progress from continual day to constant night is exceedingly gradual. To an inhabitant of an oblique sphere, the twilight is longer in proportion as the place is nearer the elevated pole.

Were it not for the power the atmosphere has of dispersing the solar light, and scattering it in various directions, no objects would be visible to us out of direct sunshine; every shadow of a passing cloud would involve us in midnight darkness; the stars would be visible all day; and every apartment into which the sun had not direct admission would be involved in the obscurity of night. The scattering action of the atmosphere on the solar light is greatly increased by the irregularity of temperature caused by the sun, which throws the atmosphere into a constant state of undulation; and by thus bringing together masses of air of different temperatures, produces partial reflections and refractions at their common boundaries, by which means much light is turned aside from a direct course, and diverted to the purposes of general illumination.\*

\* Sir J. Herschel.

In the upper regions of the atmosphere, as on the tops of very high mountains, where the air is too much rarefied to reflect much light, the sky assumes a black appearance, and the stars become visible in the daytime.

Although the atmosphere is usually so transparent, that it is invisible to us, yet we as truly move and live in a fluid as fishes that swim in the sea. Considered in comparison with the whole earth, the atmosphere is to be regarded as a thin layer investing the surface, like a film of water covering the surface of an orange. Its actual height, however, is over a hundred miles, though we cannot assign its precise boundaries. Being perfectly elastic, the lower portions, bearing as they do, the weight of all the mass above them, are greatly compressed, while the upper portions having little to oppose the natural tendency of air to expand, diffuse themselves widely. The consequence is, that the atmosphere undergoes a rapid diminution of density, as we ascend from the earth, and soon becomes exceedingly rare. At so moderate a height as seven miles, it is four times rarer than at the surface, and continues to grow rare in the same proportion, namely, being four times less for every seven miles in ascent. It is only, therefore, within a few miles of the earth, that the atmosphere is sufficiently dense to sustain clouds and vapours, which seldom rise so high as eight miles, and are usually much nearer to the earth than this. So rare does the air become on the top of Mount Chimborazo, in South America, that it is incompetent to support most of the birds that fly near the level of the sea. The condor, a bird which has remarkably long wings, and a light body, is the only bird seen towering above this lofty summit. The transparency of the atmosphere,—a quality so essential to fine views of the starry heavens,—is much increased by containing a large proportion of water, provided it is perfectly dissolved, or in a state of invisible vapour. A country at once hot and humid, like some portions of the torrid zone, presents a much brighter and more beautiful view of the moon and stars, than is seen in cold climates. Before a copious rain, especially in hot weather, when the atmosphere is unusually humid, we sometimes observe the sky to be remarkably resplendent, even in our own latitude. Accordingly, this unusual clearness of the sky, when the stars shine with unwonted brilliancy, is regarded as a sign of approaching rain; and when, after the rain is apparently over, the air is remarkably transparent, and distant objects on the earth are seen with uncommon distinctness, while the sky exhibits an unusually deep azure, we may conclude that the serenity is only temporary, and that the rain will probably soon return.

## LETTER VI.

### THE SUN.

“Great source of day! best image here below  
Of thy Creator, ever pouring wide,  
From world to world, the vital ocean round,  
On Nature write, with every beam, His praise.”—THOMSON.

THE subjects which have occupied the preceding Letters are by no means the most interesting parts of our science. They constitute, indeed, little more than an introduction to our main subject, but comprise such matters as are very necessary to be clearly understood, before one is prepared to enter with profit and delight upon the more sublime and interesting field which now opens before us.

We will begin our survey of the heavenly bodies with the SUN, which first claims our homage, as the natural monarch of the skies. The moon will next occupy our attention; then the other bodies which compose the solar system, namely, the planets and comets; and finally, we shall leave behind this little province in the great empire of Nature, and wing a bolder flight to the fixed stars.

The *distance* of the sun from the earth is about ninety-five millions of miles. It may perhaps seem incredible to you, that astronomers should be able to determine this fact with any degree of certainty. Some, indeed, not so well informed as yourself, have looked upon the marvellous things that are told respecting the distances, magnitudes, and velocities, of the heavenly bodies, as attempts of astronomers to impose on the



credulity of the world at large ; but the certainty and exactness with which the predictions of astronomers are fulfilled, as an eclipse, for example, ought to inspire full confidence in their statements. I can assure you, my dear friend, that the evidence on which these statements are founded are perfectly satisfactory to those whose attainments in the sciences qualify them to understand them ; and, so far are astronomers from wishing to impose on the unlearned, by announcing such wonderful discoveries as they have made among the heavenly bodies, that no class of men have ever shown a stricter regard and zeal than they for the exact truth, whenever it is attainable.

Ninety-five millions of miles is indeed a vast distance. No human mind is adequate to comprehend it fully ; but the nearest approaches we can make towards it are gained by successive efforts of the mind to conceive of great distances, beginning with such as are clearly within our grasp. Let us, then, first take so small a distance as that of the breadth of the Atlantic ocean, and follow, in mind, a ship, as she leaves the port of New York, and, after twenty days' steady sail, reaches Liverpool. Having formed the best idea we are able of this distance, we may then reflect, that it would take a ship, moving constantly at the rate of ten miles per hour, more than a thousand years to reach the sun.

The diameter of the sun is towards a million of miles ; or, more exactly, it is eight hundred and eighty-five thousand miles. One hundred and twelve bodies as large as the earth, lying side by side, would be required to reach across the solar disk ; and our ship, sailing at the same rate as before, would be ten years in passing over the same space. Immense as is the sun, we can readily understand why it appears no larger than it does, when we reflect, that its distance is still more vast. Even large objects on the earth, when seen on a distant eminence, or over a wide expanse of water, dwindle almost to a point. Could we approach nearer and nearer to the sun, it would constantly expand its volume, until finally it would fill the whole vault of heaven. We could, however, approach but little nearer to the sun without being consumed by the intensity of his heat. Whenever we come nearer to any fire, the heat rapidly increases, being four times as great at half the distance, and one hundred times as great at one tenth the distance. This fact is expressed by saying, that the heat increases as the square of the distance decreases. Our globe is situated at such a distance from the sun, as exactly suits the animal and vegetable kingdoms. Were it either much nearer or much more remote, they could not exist, constituted as they are. The intensity of the solar light also follows the same law. Consequently, were we nearer to the sun than we are, its blaze would be insufferable ; or, were we much further off, the light would be too dim to serve all the purposes of vision.

The sun is one million four hundred thousand times as large as the earth ; but its matter is not more than about one fourth as dense as that of the earth, being only a little heavier than water, while the average density of the earth is more than five times that of water. Still, on account of the immense magnitude of the sun, its entire quantity of matter is three hundred and fifty thousand times as great as that of the earth. Now, the force of gravity in a body is greater, in proportion as its quantity of matter is greater. Consequently, we might suppose, that the weight of a body (weight being nothing else than the measure of the force of gravity) would be increased in the same proportion ; or, that a body, which weighs only one pound at the surface of the earth, would weigh three hundred and fifty thousand pounds at the sun. But we must consider, that the attraction exerted by any body is the same as though all the matter were concentrated in the centre. Thus, the attraction exerted by the earth and by the sun is the same as though the entire matter of each body were in its centre. Hence, on account of the vast dimensions of the sun, its surface is one hundred and twelve times further from its centre than the surface of the earth is from its centre ; and, since the force of gravity diminishes as the square of the distance increases, that of the sun, exerted on bodies at its surface, is (so far as this cause operates) the square of one hundred and twelve, or twelve thousand five hundred and forty-four times less than that of the earth. If, therefore, we increase the weight of a body three hundred and fifty-four thousand times, in consequence of the greater amount of matter in the sun, and diminish it twelve thousand five hundred and forty-four times, in consequence

of the force acting at a greater distance from the body, we shall find that the body would weigh about twenty-eight times more on the sun than on the earth. Hence, a man, weighing three hundred pounds would, if conveyed to the surface of the sun, weigh eight thousand four hundred pounds, or nearly three tons and three quarters. A limb of our bodies, weighing forty pounds, would require to lift it a force of one thousand one hundred and twenty pounds, which would be beyond the ordinary power of the muscles. At the surface of the earth, a body falls from rest by the force of gravity, in one second, sixteen and one twelfth feet; but at the surface of the sun, a body would, in the same time, fall through four hundred and forty-eight and seven tenths feet.

The sun turns on his own axis once in a little more than twenty-five days. This fact is known by observing certain dark places seen by the telescope on the sun's disk, called *solar spots*. These are very variable in size and number. Sometimes, the sun's disk, when viewed with a telescope, is quite free from spots, while at other times we may see a dozen or more distinct clusters, each containing a great number of spots, some large and some very minute. Occasionally, a single spot is so large as to be visible to the naked eye, especially when the sun is near the horizon, and the glare of his light is taken off. One measured by Dr. Herschel was no less than fifty thousand miles in diameter. A solar spot usually consists of two parts, the *nucleus* and the *umbra*. The nucleus is black, of a very irregular shape, and is subject to great and sudden changes, both in form and size. Spots have sometimes seemed to burst asunder, and to project fragments in different directions. The umbra is a wide margin, of lighter shade, and is often of greater extent than the nucleus. The spots are usually confined to a zone extending across the central regions of the sun, not



Fig. 23.

exceeding sixty degrees in breadth. Fig. 23 exhibits the appearance of the solar spots. As these spots have all a common motion from day to day, across the sun's disk—as they go off at one limb, and, after a certain interval, sometimes come on again on the opposite limb, it is inferred that this apparent motion is imparted to them by an actual revolution of the sun on his own axis. We know that the spots must be in contact, or very nearly so at least, with the body of the sun, and cannot be bodies revolving around it, which are projected on the solar disk when they are between us and the sun; for, in that case, they would not be so long in view as out of view, as will be evident from inspecting the following diagram. Let S, Fig. 24, represent the sun, and *b* a body

revolving round it in the orbit *a b c*; and let E represent the earth, where, of course, the spectator is situated. The body would be seen projected on the sun only while passing from *b* to *c*, while, throughout the remainder of its orbit, it would be out of view, whereas no such inequality exists in respect to the two periods. If you ask, what is the *cause* of the solar spots, I can only tell you what different astronomers have supposed respecting them. They attracted the notice of Galileo, soon after the invention of the telescope, and he formed an hypothesis respecting their nature. Supposing the sun to consist of a solid body embosomed in a sea of liquid fire, he believed that the spots are composed of black cinders, formed in the interior of the sun by volcanic action, which rise and float on the surface of the fiery sea. The chief objections to this hypothesis are, first, the *vast extent* of some of the spots, covering, as they do, two thousand millions of square miles, or more—a space which it is incredible should be filled by lava in so short a time as that in which the spots are sometimes formed; and, secondly, the *sudden disappearance* which the spots sometimes undergo, (Fig. 2, 3), a fact which can hardly be accounted for by supposing, as Galileo



did, that such a vast accumulation of matter should disappear all at once beneath the fiery flood. Moreover, we have many reasons for believing that the spots are *depressions* below the general surface.

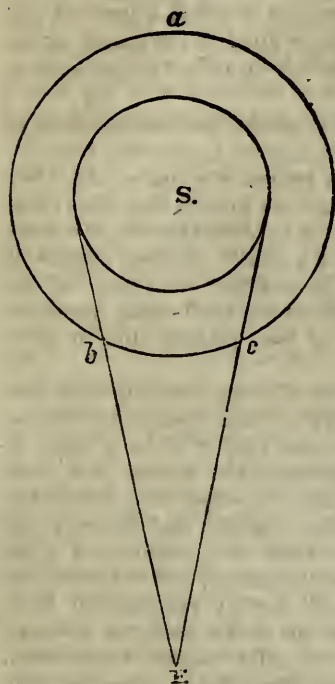


Fig. 24.

Lalande, an eminent French astronomer of the last century, held that the sun is a solid, opaque body, having its exterior diversified with high mountains and deep valleys, and covered all over with a burning sea of liquid matter. The spots he supposed to be produced by the flux and reflux of this fiery sea, retreating occasionally from the mountains, and exposing to view a portion of the dark body of the sun. But it is inconsistent with the nature of fluids, that a liquid, like the sea supposed, should depart so far from its equilibrium, and remain so long fixed, as to lay bare the immense spaces occupied by some of the solar spots.

Dr. Herschel's views respecting the nature and constitution of the sun, embracing an explanation of the solar spots, have, of late years, been very generally received by the astronomical world. This great astronomer, after attentively viewing the surface of the sun, for a long time, with his large telescopes, came to the following conclusions respecting the nature of this luminary. He supposes the sun to be a planetary body like our earth, diversified with mountains and valleys, to which, on account of the magnitude of the sun, he assigns a prodigious extent, some of the mountains being six hundred miles high, and the valleys proportionally deep. He employs in his explanation no volcanic fires, but supposes two separate regions of dense clouds floating in the solar atmosphere, at different distances from the sun. The exterior stratum of clouds

he considers as the depository of the sun's light and heat, while the inferior stratum serves as an awning or screen to the body of the sun itself, which thus becomes fitted to be the residence of animals. The proofs offered in support of this hypothesis are chiefly the following: first, that the appearances, as presented to the telescope, are such as accord better with the idea that the fluctuations arise from the motions of clouds, than that they are owing to the agitations of a liquid, which could not depart far enough from its general level to enable us to see its waves at so great a distance, where a line forty miles in length would subtend an angle at the eye of only the tenth part of a second; secondly, that since clouds are easily dispersed to any extent, the great dimensions which the solar spots occasionally exhibit are more consistent with this than with any other hypothesis; and, finally, that a lower stratum of clouds, similar to those of our atmosphere, was frequently seen by the Doctor, far below the luminous clouds which are the fountains of light and heat.

Such are the views of one who had, it must be acknowledged, great powers of observation, and means of observation in higher perfection than have ever been enjoyed by any other individual; but, with all deference to such authority, I am compelled to think that the hypothesis is encumbered with very serious objections. Clouds analogous to those of our atmosphere (and the Doctor expressly asserts that his lower stratum of clouds are analogous to ours, and reasons respecting the upper stratum according to the same analogy) cannot exist in hot air; they are tenants only of cold regions. How can they be supposed to exist in the immediate vicinity of a fire so intense, that they are even dissipated by it at the distance of ninety-five millions of miles? Much less can they be supposed to be the depositories of such devouring fire, when any thing in the form of clouds, floating in our atmosphere, is at once scattered and dissolved by the accession of only a few degrees of heat. Nothing, moreover, can

be imagined more unfavourable for radiating heat to such a distance, than the light inconstant matter of which clouds are composed, floating loosely in the solar atmosphere. There is a logical difficulty in the case; it is ascribing to things properties which they are not known to possess; nay, more, which they are known not to possess. From variations of light and shade in objects seen at moderate distances on the earth, we are often deceived in regard to their appearances; and we must distrust the power of an astronomer to decide upon the nature of matter seen at the distance of ninety-five millions of miles.

I think, therefore, we must confess our ignorance of the nature and constitution of the sun; nor can we, as astronomers, obtain much more satisfactory knowledge respecting it than the common apprehension, namely, that it is an immense globe of fire. We have not yet learned what causes are in operation to maintain its undecaying fires; but our confidence in the Divine wisdom and goodness leads us to believe, that those causes are such as will preserve those fires from extinction, and at a nearly uniform degree of intensity. Any material change in this respect would jeopardize the safety of the animal and vegetable kingdoms, which could not exist without the enlivening influence of the solar heat, nor, indeed, were that heat any more or less intense than it is at present.

If we inquire whether the surface of the sun is in a state of actual combustion, like burning fuel, or merely in a state of intense ignition, like a stone heated to redness in a furnace, we shall find it most reasonable to conclude that it is in a state of ignition. If the body of the sun were composed of combustible matter and were actually on fire, the material of the sun would be continually wasting away, while the products of combustion would fill all the vast surrounding regions, and obscure the solar light. But solid bodies may attain a very intense state of ignition, and glow with the most fervent heat, while none of their material is consumed, and no clouds or fumes arise to obscure their brightness, or to impede their further emission of heat. An ignited surface, moreover, is far better adapted than flame to the radiation of heat. Flame, when made to act in contact with the surfaces of solid bodies, heats them rapidly and powerfully; but it sends forth, or *radiates*, very little heat, compared with solid matter in a high state of ignition. These various considerations render it highly probable to my mind, that the body of the sun is not in a state of actual combustion, but merely in a state of high ignition.

The solar beam consists of a mixture of several different sorts of rays. First, there are the *calorific* rays, which afford heat, and are entirely distinct from those which afford light, and may be separated from them. Secondly, there are the *calorific* rays, which give light, consisting of rays of seven distinct colours, namely, violet, indigo, blue, green, yellow, orange, red. These, when separated, as they may be by a glass prism, compose the *prismatic spectrum*. They appear also in the rainbow. When united again, in due proportions, they constitute white light, as seen in the light of the sun. Thirdly, there are found in the solar beam a class of rays which afford neither heat nor light, but which produce chemical changes in certain bodies exposed to their influence, and hence are called *chemical* rays. Fourthly, there is still another class, called *magnetizing* rays, because they are capable of imparting magnetic properties to steel. These different sorts of rays are sent forth from the sun, to the remotest regions of the planetary worlds, invigorating all things by their life-giving influence, and dispelling the darkness that naturally fills all space.

But it was not alone to give heat and light, that the sun was placed in the firmament. By his power of attraction, also, he serves as the great regulator of the planetary motions, bending them continually from the straight line in which they tend to move, and compelling them to circulate around him, each at nearly a uniform distance, and all in perfect harmony. I will hereafter explain to you the manner in which the gravity of the sun thus acts, to control the planetary motions. For the present let us content ourselves with reflecting upon the wonderful force which the sun must put forth, in order to bend out of their courses, into circular orbits, such a number of planets, some of which are more than a thousand times as large as the earth. Were a



ship of war under full sail, and it should be required to turn her aside from her course by a rope attached to her bow, we can easily imagine that it would take a great force to do it, especially were it required that the force should remain stationary and the ship be so constantly diverted from her course, as to be made to go round the force as round a centre. Somewhat similar to this is the action which the sun exerts on each of the planets by some invisible influence, called gravitation. The bodies which he thus turns out of their course, and bends into a circular orbit around himself, are, however, many millions of times as ponderous as the ship, and are moving many thousand times more swiftly.

(*To be continued.*)

**TECHNICAL TERMS RELATING TO BOOKS.**—A book is said to be in Folio when one sheet of paper makes but two leaves, or four pages. When the sheet makes four leaves or eight pages, it is said to be in Quarto form; eight leaves or sixteen pages, in Octavo; twelve leaves or twenty-four pages, Duodecimo; eighteen leaves, Octodecimo. These terms are thus abbreviated: fol. for folio; 4to for quarto; 8vo for octavo; 12mo for duodecimo; 18mo, 24mo, 32mo, 64mo, signify respectively that the sheet is divided into eighteen, twenty-four, &c., leaves.

The Title-page is the first page, containing the title; and a picture facing it is called the Frontispiece.

Vignette is a French term, used to designate the descriptive or ornamental picture, sometimes placed on the title-page of a book, sometimes at the head of a chapter, &c.

The Running-title is the word or sentence at the top of every page, generally printed in capitals or Italic letters.

When the page is divided into several parts by a blank space, or a line running from the top to the bottom, each division is called a column; as in Bibles, dictionaries, spelling-books, newspapers, &c.

The letters A, B, C, &c., and A2, A3, &c., at the bottom of the page, are marks for directing the book-binder in collecting and folding the sheets.

The *catch-word* is the word at the bottom of the page, on the right hand, which is repeated at the beginning of the next, in order to show that the pages succeed one another in proper order. It is seldom inserted in books recently printed.

The Italic words in the Old and New Testaments are those which have no corresponding words in the original Hebrew or Greek, but they were added by the translators to complete or explain the sense.

**SPONGE.**—This well-known production of the sea has been in use from the earliest times, and naturalists were long embarrassed whether to give it a place in the animal or vegetable kingdom. Most authorities now place it in the lowest scale of animal life. There are fifty different kinds of sponge. Sponges are found plentifully in the Mediterranean and other seas of warm climates, but diminish in number and deteriorate in quality as they approach cold latitudes. They adhere to rocks in places the least exposed to the action of currents and waves, and below low-water mark. The best sponges come from the Archipelago, where they abound near many of the islands, whose inhabitants subsist entirely by the sponge-fishery. At the Cyclades, sponge-diving forms the chief employment of the population. The sea is at all times very clear, and experienced divers can distinguish from the surface the points to which the sponge is attached below, when an unpractised eye could but dimly discern the bottom. Each boat is furnished with a large stone attached to a rope, and this the diver seizes in his hand on plunging head foremost from the stern. He does this in order to increase the velocity of his descent; thus economizing his stock of breath, as well as to facilitate his ascent when exhausted at the bottom, being then quickly hauled up by his companions. Few men can remain longer than about two minutes below; and, as the process of detaching the sponge is very tedious, three, and sometimes four divers descend successively to secure a particularly fine specimen. The best sponge is that which is the palest and lightest, has small holes, and is soft to the touch. Of old, sponge was regarded as a cure for a long list of maladies; burned sponge, still holds a place amongst the materials of medicine.

## THE MIRROR OF NATURE,

*(Continued from page 50.)*

WITH a burning desire Duval seized this spiritual nourishment. He applied himself earnestly to become the companion of the good Palemon, not only in the labour of the hands, but also in prayer and a devout life. Upon a spring morning, when the dew rested in pearls on the flowers, and the song of the nightingale was heard, as he sate upon a point of the rock above the hermitage, and the sun rose above the heights of the Vosges, his mind rose to an unwonted elevation. But he had now to learn what many before and since have experienced, when in this exaltation of mind they have forgotten the wisdom of the lark and the eagle, who, in their ascendant flight direct their eyes upwards and not below. Whoever rises on the wings of devotion like the lark, sees clearly, that although he hovers above the roofs of human dwellings, and even the pinnacles of towers, he is still far below the mountain tops, still farther beneath the clouds, and much farther again from the starry heavens. But who-soever, as he rises, looks only below and not above, and perceives below him the oaks of the forests, which are still high, as low shrubs—to such an one it may easily happen, that, seized by the dizziness of pride, he is in danger of tumbling to the earth. Our young novice in the hermit's life had this experience. Because his youthful ardour was more lively than the feelings of his older companion, because the outward expressions of his devotion were more imposing than those of the quiet, gentle brother Palemon, Duval fancied himself exalted above his friend. When Palemon gave him something to do in the garden, or sent him on an errand to Deneuvre, the lad, instead of complying, gave himself up to his devout meditations in the shade of the rock or under a tree, and to the well-merited reproof of his neglect, he replied only by bitter remarks on the lukewarmness and wordliness of his elder brother. The giddiness of pride was certainly not to be mistaken here. Experiences, fitted to set him

right, our young hermit would not indeed have wanted, had he only been always open to such instruction. Thus, on a certain evening, when four canons from Deneuvre, stopped at the hermitage, and partook of refreshments which they had brought with them, and the remains of which were given to Duval, for the first time in his life he learned the power of wine, the effect of which he considered as the influence of the highest devotion, until the feeling of exhaustion the next day taught him otherwise.

His residence with brother Palemon continued only a short time. The superiors of the Eremite-association sent one of their members to La Rochette, to whom Duval had to submit. His kind master gave him a letter commending him to the hermits of St. Anna, at Luneville. Our young eremite had not proposed to go thither of his own mind and inclination, but as he was now diverted from the direction in which he himself first chose to travel towards the east, so it was a higher hand that, at this stage of his career, led him against his own wish and will to the right gaol. The sorrow which he felt in parting from the quiet shelter of La Rochette and from brother Palemon was as transient as that which he felt when he was taken from his strange bed in the sheep-fold, and carried, wrapt in hay and rags, to the house of the good pastor where he was restored to health. Those ways of Providence, which best serve our welfare, are generally opposite to our wishes; they cross our own ways, and yet lead to peace, while the ways we would have chosen lose themselves in pathless wastes.

With anxious heart Duval wandered through the forest of Modon into the open country, where lay before him the flourishing city of Luneville, with its beautiful castle, the residence of the Duke of Lorraine. Uneasy as a wild bird, brought for the first time in the new prison of his cage into the crowd of a market-place, our young hermit mingled shyly with the well-dressed throng of this metropolis, and hardly dared to turn his eyes to the grand castle of the prince, which seemed to intimate the neighbourhood of beings of a higher kind. He breathed freely again, only when he found himself



again clear of the city on the road to the west, which had been shown him as the way to St. Anna.

The hermitage of this name lies a half league on the other side of Luneville, on the southern side of a hill, near the spot where the Meurthe and Vesouze unite their waters. The forest of Vitrimont, which borders them to the north, much thicker then than now, increased the beauty of the country, while in winter it kept off the cold wind from the north, and in summer afforded shade and coldness. But a few years before, the spot now highly cultivated had been a waste of thistles and thorns, which still showed traces of the desolating times of the Thirty Years' War. A former lieutenant of cavalry, who, severely wounded in battle, had been left for dead under the hoofs of the horses, and had been restored to life, without any desire, however, to return to its active pursuits, was the founder of the hermitage of St. Anna; and only a few years before had died nearly a hundred years old. Brother Michael, so the founder was called, had purchased an old mansion named Alba, near the forest of Vitrimont, had associated with himself some other individuals, and with their assistance had transformed the barren spot, which comprised twelve acres of land, into an estate, the produce of which supported six cows, and four or five men, who, without needing assistance, were able to give charity to others. In several other quarters, also, the good brother Michael had made himself useful by similar establishments, in promoting the culture of the land and the improvement of individuals; for several of the companions of his lonely life had previously been vagrants, who, first led by necessity, became bound to him by love; and the influence of his example, the force of his sincere piety, transformed them into better men.

Duval, in anxious expectation of his fate, presented himself at the door of the hermitage. Brother Martinian, one of the four inmates received him, and returning his greeting, took from his hand his letter of recommendation, introduced him to his brothers as a future servant of the house, bade him be seated and partake of the rustic fare which he placed before him. The new-comer soon felt him-

self at home among these good people. They were men of peasant-like appearance, but of true hearts. They had indeed, not that finely cultivated sense which teaches politeness and grace, but the yet more tender feeling of hearts under divine discipline, which tells us what is right and guides our steps in a straight path. Duval bears witness particularly in regard to three of these individuals; that they never indeed talked about virtue, but practised it unseen by the world. His five years' residence among them showed him in these simple souls no trace of impurity or hypocrisy, but only the ordinary foibles of our nature. The heart of old brother Paul, who had then dwelt two and thirty years in the hermitage, had become a temple of humility and love; and the inward peace which such a temper gives, showed itself in his whole deportment. He spake less, but did more than the others, for, as he said, it happens with us that, with the best will, we more easily and oftener sin in words than in deeds. He was gentle, patient, tender-hearted and so invariably cheerful, that it seemed as if no emotion of human passion could disturb his spirit. Nothing took him by surprise; in thunder and lightning as in the stillness of a spring morning, in cold as in the heat of summer, he remained in the same even state. He did not seem able to comprehend how one could hate, and when Duval once asked him in jest, whether one might not at least hate the devil, the good man replied with grave simplicity, "We must hate no one."

The first business which the old hermits intrusted to their robust young mate was the care of the cows, which he had to drive to pasture in the forest. This employment was not entirely to his taste. From all such mean occupations he had believed himself free from the time he had quitted Clezantine. His residence with brother Palemon had produced and nurtured in him the notion that he was destined for something better than tending cattle. Yet a glance at the kind brother Paul and the grave face of brother Martinian taught him silence and obedience. With whip in hand, he drove his cows to the forest. Self-conquest, the victory gained over a proud self-will, is always a rich source of peace. Our young herdsman soon per-

formed with pleasure the service, which at first he had undertaken with no good will.

The honest fathers wished, not only to train their pupil to rustic employments, but also to educate him for their society and make a scholar of him also. One of them, who, in comparison with the others, represented the learned man, and valued himself somewhat on the score of this privilege, had learned the art of writing, and when he remarked the extraordinary curiosity with which Duval's eye followed his pen, he resolved to make the lad a sharer of his art. With a hand trembling with age and daily toil, he wrote for the youth the letters which the latter faithfully copied, forming them as rudely as they were represented. But the zeal of the pupil exceeded the ability of his old teacher. The one rarely had time to teach, the other thirsted continually to learn. Duval invented, therefore, a method by which he might practise himself in writing without assistance. He took a pane of glass from the window of his cell, laid it over a written paper, and with the ink, which was easily washed away, traced the letters on the glass, until at last he was able to write a stiff, old fashioned hand like his teacher. In the religious exercises of the place, which consisted of six offices of devotion, observed in common every day, the future eremite was also regular, except when the care of the cows kept him away.

But Duval's education in the hermitage of St. Anna was not confined to the art of writing. He found other means of feeding his daily increasing appetite for knowledge. The good fathers possessed several books. The cover of one of these was a rich prize to our young inquirer. It contained the first four rules of arithmetic. The delight which a poor man feels, when he unexpectedly digs up in his little garden what seems to him an immense treasure, could not be greater than Duval's when he found the key to an art, which justly appeared to him as one of the gates which open into an immeasurable realm of knowledge. Sums appeared and vanished before his eyes, as they were united by addition, or yet more increased by multiplication, and again diminished by subtraction, or still farther lessened by division — what enjoyment was thus

afforded to a mind which in the signification of numbers discerned the means of comprehending in material phenomena, the powers or properties with which the all-creating spirit has endowed the same. The young hermit had always during his herdsman's life found a special pleasure in the stillness of the woods and quiet pastures. Here at St. Anna he could enjoy this pleasure in a high degree; for scarcely any other forest resembled in loneliness and quiet this of Vitrimont, with its little valleys and ravines. At his favourite spot, a sort of grotto, the remains of an old quarry, the diligent arithmetician was often found, even in the hours of the summer night, busy with the solution of self-imposed tasks, or with weaving those thoughts which germinated in the narrow, but so much the more fruitful, soil of his daily experiences.

More powerfully than by all that he saw around him, was he attracted by the spectacle of the starry heavens. The frequent reading in the almanack had already at Clezantaine afforded him an indescribable pleasure, because the course of the moon for a whole year was therein foretold in a way to him inconceivable and prophetic. Then, too, he learned something of those heavenly signs of a ram, a bull, a lion and a crab, into which at certain seasons the sun and moon entered. Brother Palemon had told him, that those signs of which the almanack speaks, were to be found among the stars of heaven, but how, or where he knew not. Even the hermits of St. Anna could give him no information. But our Duval had no rest, he must inquire and know where the goat or the bull kept themselves hidden among the stars of heaven. On one of the highest oaks on the edge of the wood he built for himself, out of willow-twigs and ivy, a sort of throne like a stork's nest; the throne itself upon which he there sat, was the remains of an old bee-hive. Here in clear nights he spent many an hour, during which he examined with the closest attention every quarter of the heaven, in order perhaps to discover among the stars the form of one of those celestial animals. It happened with him, however, as with the deaf and dumb child, for whom the word "tree" has been written down, while the meaning of the word is defined in a pic-



ture or by the language of signs, and who in vain endeavors to discover a resemblance between the written sign and the form of a tree.

As in the material world, at the right time hunger finds its food, and every awakened want its supply, so is it in the spiritual world. The sound and honest impulse towards knowledge is under the care of the same Providence that directs the force of animal instinct to its goal. Whatever helps to invigorate and unfold, is furnished at the right time. It was just at the time of the great annual fair of St. George, at Luneville, that the hermits sent their young servant into the city, to execute certain commissions. While curiously gazing at the beautiful thing exposed for sale, he discovered, to his inexpressible joy, a celestial chart, a representation of the earth, and four maps representing the four quarters of the globe. The wages he had earned at Clezantine, remained almost entire in his possession, and this treasure, amounting to five or six francs, he had with him always in his pocket. The moment had now come to make a right investment of this hitherto dead and useless capital. With joy he gave it all to secure possession of the precious charts.

In a few days the happy Duval had got so far in the celestial chart that the relative situation of most of the constellations was known to him; it became plain to him, also, that the pictures on the charts were not drawn on the heavens, but that to every picture a group of stars belonged, which had little to do with the form of a bull or a ram. Had there only been some one to describe and name to him one of these groups, it would have been easy for him, according to their relative places on the chart, to find out the other pictures also, but he had himself to devise a means of escape from this embarrassment, and his reflections soon led him the right way.

He had learnt that the pole-star, which designates the north pole of the heavens as well as the earth, always occupies the same place. Could he only find this, so he inferred, then he would have at all hours of the night, in summer and in winter, a fixed point from which the relative places of the constellations would be ascertained. But who was to tell him

where to find in the heavens the north pole? In this uncertainty, a piece of information he had got by hearsay became of service. He had heard that there is a steel needle which always turns one end toward the north, and might therefore serve to ascertain the different quarters of the world. His earnest desire to see such a wonderful needle and make use of it, was gratified by one of the old hermits, who had in his possession a pocket compass, and willingly lent it to the eager Duval. The direction in which the pole-star is to be seen, now became known to him, but how high or low the north star stands, he knew not. This important discovery, however, was made after several vain inquiries and failures. He first tried to find the pole-star by means of a straight branch directed towards a star of the third magnitude, standing in the north. By boring this branch, he made it a tolerably large tube; if the star to which this instrument was directed was the true one, then it must always be seen through the tube. But alas! the tube was scarcely bored when the star, to which it was directed, passed from the field of vision; and not more fortunate were other experiments until at last the tube broke. Yet the curiosity of our young inquirer was not diverted from its path by such disappointments. A reed of elder, from which the pith was removed, was next fastened to the top of the large oak, that served for an observatory, in such a way that it could be turned at pleasure, up and down, to the right or to the left. This contrivance led at last to success; the pole-star was found, and therewith the key to the gradual explanation of the starry groups, and to a knowledge of the constellations.

When the living thirst for knowledge is awakened in man, it never rests satisfied with inquiring into what lies before the eyes. Even the salmon, when the migratory impulse begins to urge it, is not diverted from its course, when at one time it ascends to the source and at another descends to the mouth of the stream. So the mind of man, in the midst of the visible world, is bent upon knowing the beginning and end of all phenomena. What are these stars, Duval asked himself, and how far is it to them from my oak? More fruitlessly now than when before he

possessed the charts he tried to find the signs of animals in the heavens, did his eye exert itself to find a measure below for the things above; on all sides the desired end retreated before him; the nearer he appeared to come to it, the farther did it retire into the depths of infinity, which no inquiries of the senses, but only the inward eye of the spirit can penetrate.

Whatever may be the size of the earth, that would be more easily ascertained, so thought our advancing scholar, if the representation of the earth, which he had lying before him, could only be understood. His charts were his constant companions. In the lonely woods he spread them on the ground before him, while the cows grazed around him. What the many lines, some straight and some curved, which were drawn upon the representation of the globe—what they meant, he thought deeply for days. At last the broad girdle drawn around the middle of the earth, and divided into three hundred and sixty little black and white spaces, led him to think that they were intended to represent distances. A light rose upon him, which at once made all clear; the riddle was solved; the little spaces signified miles (he knew as yet no other measure for earthly distances), and consequently he considered that the circumference of the earth consisted of no more nor less than three hundred and sixty French miles or leagues.

He could scarcely wait for dinner-time to communicate his grand discovery to the hermits. The learned brother shook his head, but had nothing to say. One of the others had been, in his youth, at St. Nicholas de Barry, in Calabria. He stated that on that journey he had travelled more than three hundred and sixty leagues, but that land and water extended farther; a distance of three hundred and sixty miles could not reach round the earth.

*To be continued.*

**MENTAL EXCITEMENT.**—So long as excessive mental excitement is kept up, but little relief can be obtained from the strictest attention to dietetics. Abstinence from mental toil, cheerful company, a country excursion, and relaxation of mind, will soon accomplish a cure, when all the dietetic precepts and medicines in the world would prove inefficacious.

## EASTERN RAMBLES AND REMINISCENCES.

### RAMBLE THE TWENTY-SECOND.

SUMMIT OF CHEOPS—THREE CHEERS FOR OURSELVES — A NOVEL RACE — ENTRANCE TO THE PYRAMIDS—THE INTERIOR—AN INTERESTING SCENE—THE SECOND AND THIRD PYRAMIDS—THE SPHINX—ROUTE TO MEMPHIS—SAKKA-RAH—VIEW FROM THE PYRAMID—THE IBIS PITS—MEMPHIS—THE REMAINS—DEPARTURE FROM CAIRO.

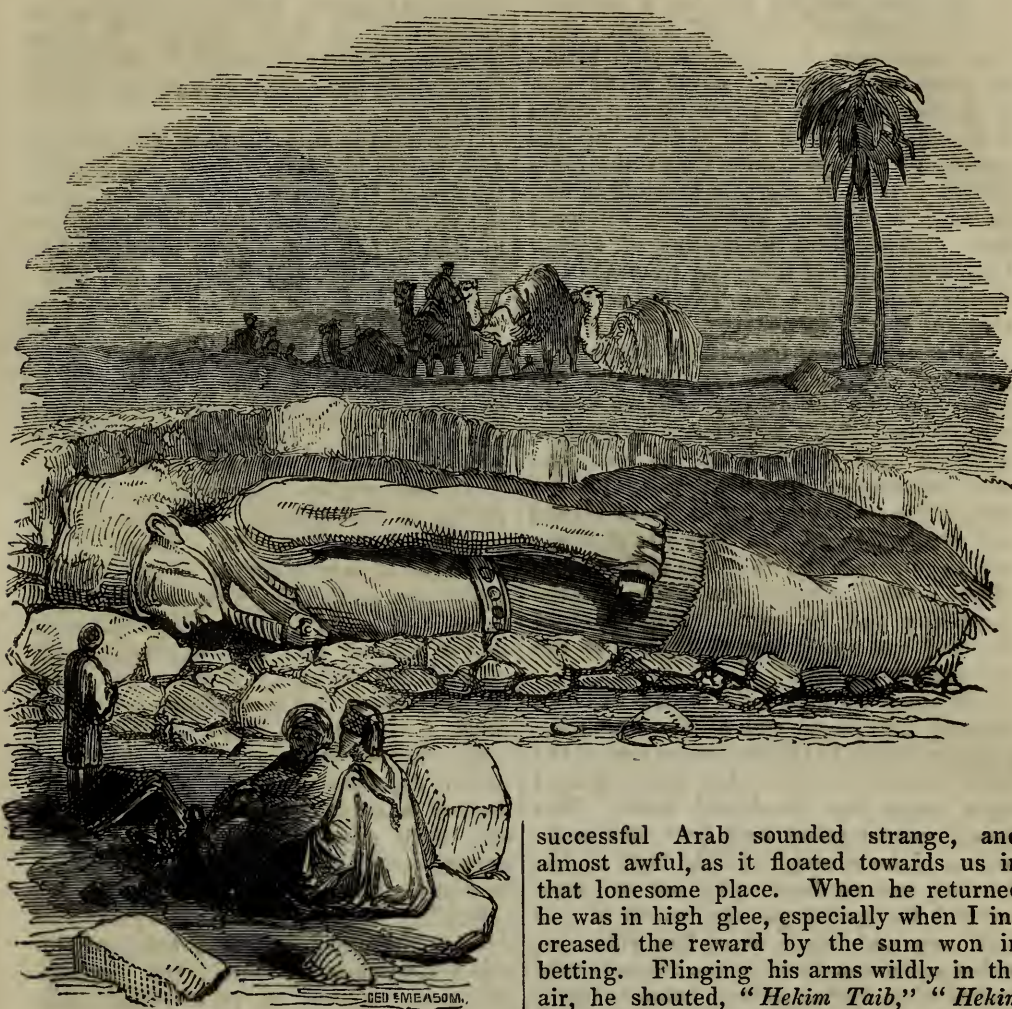
“There is more  
In such a survey than the sating gaze  
Of wonder pleased, or awe which would adore  
The worship of the place.” **BYRON.**

“Memphis—still grand, though not the same  
Unrival’d Memphis, that could seize  
From ancient Thebes the crown of Fame,  
And wear it bright through centuries.”  
**MOORE.**

WHEN on the platform that now constitutes the apex of Cheops, we either cut or wrote our names on the stones, like most of the travellers that had preceded us, and to commemorate the event and our ascent of this wonder of art and memorial of despotism, we had some whiskey - punch, sang, “God save the Queen,” “Rule Britannia,” and “Hearts of Oak,” and gave three hearty cheers, such as British tars always give.

Just as we were about to descend, I thought we might have some sport—even at the pyramids—and therefore, selecting one of the finest Arabs, I promised him five piastres (about one shilling) to ascend the second pyramid, and procure me a piece of the plaster from the summit. Away he went, delighted at the idea of receiving so much for what appeared to him so little, and in five minutes and a half from the time he reached the base of Cheops, he was on the summit of the second pyramid, having passed over about 200 yards of sand, in addition to the height of the pyramid. He then descended in eleven minutes, and was soon at my side claiming his reward. But, our sport was not over yet. I now held up a dollar, and promised that it should be given to the first man that stood upon the summit of





STATUE OF RAMESES.

Chephrenes (the Second Pyramid), and as this was nearly sufficient to feed one of the Arabs for a month, the competition was brisk. Away they went, when I clapped my hands, and almost appeared to fly down the sides of Cheops, across the sands, and up the sides of Chephrenes. We bet on our men as freely as upon horses, and although I took the man that started the first time, I won; for he reached the top of the second pyramid in nine minutes and a half from the time of the starting. It was a curious sight to see the Arabs climbing up the sloping sides of the pyramid, looking mere specks upon its vast sides; and the voice of the

successful Arab sounded strange, and almost awful, as it floated towards us in that lonesome place. When he returned he was in high glee, especially when I increased the reward by the sum won in betting. Flinging his arms wildly in the air, he shouted, "*Hekim Taib*," "*Hekim Bashan*," and clapped his hands with great glee.

Having received such a well paid piece of flattery, I descended with the rest of the party to the main entrance, which is about fifty feet above the base, and nearly in the centre; below us was a heap of rubbish, and large stones thrown down from the pyramid, which, with the sand of the desert, formed an inclined plane leading to the entrance.

Having removed all our superfluous garments, and given them, with other things we did not want, in charge of our *cui-bono* friend, we lighted our tapers and we descended into the dark passage leading into the interior of the pyramid. The passage, which is about three feet wide, five feet eight inches high, ninety-six feet long,

is very dusty and hot, and has a descending inclination of about  $26^{\circ}$  or  $27^{\circ}$ . It is lined above and on each side with blocks of compact limestone, which many persons have mistaken for granite, as it differs from that used for the outside of the pyramid.\* These stones are so admirably united that it is scarcely possible to discover their junction, and this is rendered more difficult from the coating of carbon they have received from the thousands of torches and candles that have passed along that hot and dusty passage.

After arriving at the end of the sloping passage, half choked with dust and oppressed by the suffocating heat, we had to turn to the right, a huge block of granite formerly used to block up the entrance, now intercepted our continuing in the proper line; when this pyramid was opened this block presented an obstacle that was not anticipated, and as it was too large to move, a false passage was made into the ascending one, by cutting away part of the roof and upper part of the side of the descending passage.

Crawling through this forced way, we entered the lower end of the ascending passage, which is 109 feet long, and of the same size as the one we had just left, but with rough and blackened sides. The ascent was fatiguing both from the inclination of the passage, and the heat of the torches and confined air; but we soon entered the grand passage, which is 158 feet long and nearly seven feet wide; on either side are inclined ledges, about twenty inches wide, having oblong holes in them, at intervals of about three feet, and the space between the ledges looking deep and dismal.

Having crawled along the ledges by means of the oblong holes, we entered a sort of ante-chamber, above which two blocks of granite are to be seen, forming a portcullis, which was intended to block up the entrance from naughty antiquaries, and destructive travellers; but for fear one of these obstructions should not be enough there were three others, in the open space

above our heads: however, travellers, or antiquaries, or both, thought it better that they should be removed, so the granite portcullises have been broken and carried away.

Leaving the ante-chamber, with its dust and smoke-blackened walls, we entered the Grand Chamber, which is also called the King's Chamber, it is thirty-four feet four and a half inches long, seventeen feet two inches wide, and nineteen feet high; the floor, sides, and roof are made of large and beautiful tables of Thebaic marble (granite), which are so accurately fitted together that it is almost impossible to pass even a filament straw between the joints, and this is the more extraordinary because there is no cement to prevent it.

At the western extremity is a sarcophagus of real granite, which sounds like a gong when struck with a hammer. It is devoid of hieroglyphics or any kind of sculptures, and although chipped here and there it is pretty perfect with the exception of its lid, which was perhaps carried off with the contents. There is one thing peculiar about this sarcophagus,—it rests upon a very large block of granite, so large that it exceeds all the others of which the floor is made. Travellers—learned ones, too—have noticed the fact, and have concluded that the block of granite covers the entrance to a passage, or perhaps another chamber; and the enterprising Colonel Howard Vyse, who opened the third pyramid, has partially excavated under the block, but not with the same success or perseverance that has generally accompanied his exertions. The sarcophagus is eight feet long outside, and seven and a half feet inside: three and a half feet broad, and three and a half feet deep outside, and three feet inside; being in fact six inches thick.

Our Arab guide lit some rushes in the sarcophagus, and at the same time one of our party fired a pistol, which produced a deafening echo, the reverberation rattling above, below, and around us, startling the wild Arabs gathered around the sarcophagus, and adding some interest to the Rembrandt-looking scene by fixing the various groups within the chamber in a listening attitude. Oh! for a Mayall or a Claudet to fix that scene upon their unflattering plates. The wild gaunt Arabs,

\* The limestone used for the courses outside the pyramid is a soft testaceous limestone, abounding with small petrifications, and was quarried from the adjacent rocks; while that used for lining the passage was brought from the quarries opposite the site of Memphis.



with their blue cotton gowns exposing sufficient of their dark sinewy limbs to make them even more wild-looking than their ruffled beards and unwashed faces could make them; the flickering light dancing in the sarcophagus that once received the remains of the sacred Apis, now lighting the countenances of all those gathered around, and flashing upon the sombre walls of that mysterious chamber, then sinking again into the dark sepulchral abyss; anon, its expiring light tinged the outlines of the assembled few, and then, once more descending to thee expiring embers in the tomb of "the worshipped bull," hovered over them like hope upon the death-bed of a repentant sinner. A rushing hissing sound, succeeded by a slight crackling noise, sulphurous smoke, and erratic flame, announced that a lucifer-match had been ignited; and now the torches flare with uncertain flame, and shouts proclaim that the British tars have again essayed to awake the echoes of that vast and venerable pile. Three cheers succeed some songs proclaiming that a health may be obtained for all good lasses at the pyramids, and that this is the real old house at home (not in the desert) where our forefathers dwelt, and some other extraordinary statements, one of which especially informed us that there was "nae luck about the house." Therefore, upon the strength of such wholesome advice we left the King's Chamber, and descended to the Grand Passage, from which some of us ascended to the chamber discovered by Davidson, the Consul at Algiers. To reach this place we had to climb up by means of small notches cut in the rock, and also the aid of a rope lowered by an Arab, then to crawl along a passage which is not more than two and a half feet wide, until we arrived in the chamber, which is only seventeen feet wide, three feet eight inches high, and forty feet long. Satisfied with having explored thus far we descended, because the ascent to the other chambers is more difficult and dangerous.

Returning by the Grand Passage, and form thence to the horizontal passage, which is not quite four feet high, and only three and a half feet wide, we came to the entrance of the "Queen's" Cham-

ber, after crawling along the passage for about thirty yards.

The chamber is nineteen feet long, seventeen broad, and about thirteen to the commencement of the roof, and six or seven more to the summit; the roof is angular, being formed by the inclination of large masses of stone, leaning towards each other. The floor, sides, and roof are made of compact limestone, which is encrusted with salt to the extent of half an inch in thickness in some places, and thicker in others. It is partially filled with loose and broken stones, which have been thrown down from a forced passage, the entrance to which is about four feet from the floor, and four feet square. Leaving this we returned the same way, and arrived at the entrance of "the well," which is two feet square. The descent is dangerous and unprofitable, therefore we bade adieu to the interior, and re-traversing the passages arrived at the entrance; when we reclothed ourselves, and having mounted our donkeys, left the great pyramid, which some persons imagine contains 3,700 chambers of the same size as the King's Chamber; but this is entering upon a question we do not feel inclined to combat on either side.

Away we went to get a glimpse of the Second Pyramid, commonly called Belzoni, but more correctly that of Chephrenes, which is little inferior in magnitude to the first, and stands on ground thirty feet higher than that on which the first rests. Its summit is almost entire, a large portion of its casing remaining on the upper part, and forming a smooth cap, which extends about a quarter of the distance from the apex to the base.

There is little of interest in this or the *Third Pyramid*, opened by Colonel Vyse, who found in it the mummy-case of its founder, who was kind enough to leave his name behind, to let us know something about him—and that something is a mere nothing. All we know is, that his name was Menkaré—at least the hieroglyphic readers say so—and therefore we have been forthwith requested to call this pyramid Mencheres.

Passing by the minor and insignificant pyramids and tombs adjoining, we paused to notice the great Sphinx, situated at a short distance from the south-eastern

angle of the pyramid of Cheops, and rearing its head to the height of sixty-two feet, while its huge back lies buried beneath the sand of centuries. It is sculptured from limestone, and the once placid countenance is now disfigured by cracks, and the loss of many portions of the sculpture, which make it look absolutely ugly when near, but, nevertheless, does not destroy its once sweet expression when seen from a distance, with the mighty Cheops in the background on the right, and Chephrenes on the left, while before us the outstretched paws appear to be almost treacherously concealed under the sand and rubbish. It was a picturesque sight to behold these venerable relics towering above all, while the camels and their drivers, the Arabs, guides, and our donkey-drivers, formed a group on the burning sand, perhaps discussing the amount of backsheesh, or the folly of the English in taking so much trouble to see "the ugly old stones." \*

Caviglia caused the sand to be removed from around the sphinx, so as to enable him to examine it carefully below; this he did with considerable difficulty, but yet he succeeded in discovering that the body is formed chiefly from the solid rock, and that the paws, which are built of pieces of limestone, project forward fifty feet from the body, and contain a small temple formed by the junction of several sculptured tablets. The face is regarded as a likeness of Thothmes IV., who reigned about 1697 years B.C.; if it is a correct one, he must have been a good-tempered kind of a man, if we may judge by remains of its colossal countenance.

We now looked our last upon the monarch monument of the desert, that has resisted not only the silent ravages of many thousands of years, but also the attempts of many Saracenic kings to destroy it as a record of idolatrous worship, and, proceeding over the desert, passed through groves of acacia, palm and date-trees—and at times through, or by, a mud village, where we were saluted on all sides by women and children, clamorous for a present; and after four hours' ride arrived at the base of the principal pyramid of Sakkarah, which is built of unburnt brick,

in five stages, and supposed to be of greater antiquity than those of Ghizeh. It has a chamber with a kind of vaulted roof, braced here and there by beams of sycamore wood. Here we obtained one of the most beautiful views that it is possible to get in that region, commanding the whole country of the pyramids, because it is nearly midway between those at the most extreme points, around is the vast and boundless desert, with its heavy waves of sand, destructive, uncertain, and ever changing; to the north-east, but afar off, the Mokattin Mountains rear their dusky sides, and the minarets of Cairo glitter in the sunshine; at the foot of the dark Mokattin Range the fertile Nile rolls onward, rejoicing in its strength, as it flows from Thebes and Dendera, and rushing past the now neglected Memphis, hurries to the city of the great, and the glorious now departed. Away to the north the Pyramids of Ghizeh rear their stupendous forms, and those of Dashour in the south, to compete with them, but in vain. Below is the Necropolis, with its unnumbered tombs; a sad memorial, a vast city of the departed.

Leaving the pyramid we scrambled down the *ibis pits*, amidst such clouds of dust and sand that we were nearly smothered, especially as the smoke from the pine-torches was very dense. The chambers are full of earthen pots, containing the embalmed birds, arranged with great precision, and apparently endless in extent, many of those which I examined were so well preserved that even the feathers were perfect, but they crumbled to dust on touching them, or after long exposure to the air. Near to the ibis pits were some very interesting tombs, in a remarkable state of preservation, as regards the colours, but sadly mutilated in the various parts. Around these tombs the sand of the desert was strewn with fragments of ibis pots, bones, pieces of mummy-clothes, and other sacred relics, or rather relics sacred to the ancient Egyptians.

Leaving this spot we rode on towards Memphis, the ancient rival of Thebes, but now, alas! almost unknown.\* True, that many savans had long ago determined its

\* See engraving, p. 13.

\* Recent accounts from Alexandria state that the French have opened a gallery, which is 2,000 feet long, and tunnelled into the hills. Its sides



site to a certain extent, placing it in the midst of a forest of luxuriant palms, which lies between Ghizeh and Sakkarah, on the left bank of the sacred river, extending for many miles.

The graceful date-palm, called by the Hebrews *tamar*, and by the Greeks *phoenix* (*φοινῖξ*), is the palm-tree of Scripture. It is a most valuable tree to the natives, the leaves are made into baskets, hats, &c., after being steeped in water; the fibres of the stem of the leaves are made into cords, mats, and brushes; the trunk furnishes them with a hard and durable wood when old, from which many useful articles of household furniture are made; a liquor is also obtained from the trunk, which is called palm wine; the fruit furnishes a grateful syrup, which has received the name of date-honey; by fermentation they obtain a wine, and distillation supplies them with a spirit which is employed in the manufacture of perfumes. Then there is the date bread, which is a mass of stoned dates pressed together, and is in great request as a sweetmeat; and the date flour, which is so invaluable to the Bedouin, it is made by drying the fruit in the sun, and reducing it to a fine powder, which can be conveniently carried on long journeys, and made into a paste with a little water when required. Nor do they even waste the stones, for they supply the cattle with food, so that every part of the *phoenix dactylifera*, or date-palm, is used by the Arabs, who are, generally speaking, a careful people. The palm-tree is symbolical of Judea, and is figured on the coins of Vespasian, where a female is represented sitting in a sorrowful posture under a palm-tree, while around her is the legend "JUDÆA CAPTA," and on the other side of the palm-tree is a Roman soldier, with his foot resting upon a helmet. Date-trees are divided into male and female, one tree bearing fruit, and another blossoms. Each tree when in a good condition yields from 200 to 300 lbs of fruit, which is gathered in ten or a dozen bunches.

The site of Memphis was discovered by Caviglia, who found two statues. The principal one being colossal, and lying in a hollow, face downwards, to which cir-

are said to have many cells, each of which contains a large sarcophagus, the last resting-places of the sacred bulls.

cumstance the present perfect condition of the features is no doubt owing. It is supposed to be part of the statue of Rhamses, or Rameses the Great, or at least of one of the six statues that he erected before the Temple of Vulcan, to represent himself, his wife, and four sons. Above and beyond the hollow in which it lay was the desert, with the palms of Memphis, and a string of camels laden with merchandize journeying towards the Nile; and there lay the pride of the Egyptian sculptor, amid a heap of rubbish and stagnant water, the countenance calm and significant of the Egyptian type, and the proportions and execution, bearing evidence that it was sculptured during the brightest ages of that oppressed land. The length is thirty-seven feet four inches, the breadth nine feet nine inches, and depth six feet three inches.

About one hundred and fifty yards from this is the other figure, which is only about ten feet long, carved from Egyptian granite, and not worth the trouble of the walk to see it.

Memphis is the ancient Busiris (mentioned by Pliny), and modern Abousir. It possesses two brick and four stone pyramids, and on a slab in one of the former is engraven the following inscription,—“Compare me not with the stone pyramids, for I am as superior to them as Jove is to the other gods. Thus was I made; men probing with poles the bottom of a lake drew forth the mud which adhered to them, and formed it into bricks.” This fact, for which I am indebted to the work of Sir Gardiner Wilkinson, proves that the stone pyramids were erected prior to the brick ones, unless the slab and the inscription are fabrications.

Leaving Memphis, we made for a pretty little shady spot on the banks of the Nile, where we had some refreshment, and then repaired on board a cattle boat that was near at hand. A smart breeze aided us, and we were soon gliding tranquilly down the Nile towards Ghizeh.

Soon the moon peered from behind the sable clouds, and her soft light, stealing through the quivering foliage of the luxuriant trees that decked the banks of that renowned river, danced in merry mood upon its broad bosom, between the long dark shadows flung from those trees, and

then, the distant songs of the Nile boatmen hanging on the evening breezes were gently wafted towards us, while Memphis gradually faded from our sight. The lights from the village gleam in the distance, and the hum of its crowds betoken our approach to Ghizeh, but still we are on the tranquil current of the Nile:

"O river of renown!  
 Rich are the ancient shores  
 Made fertile by thy flow, in piles that stand  
 To point how far the feeble spirit soars  
 Above the land:  
 Thy wave sublime o'er-sweeps the marvellous  
 ground,  
 A marvel more profound.  
 The Pyramids are there;  
 Yet once the sunshine fell upon the spot  
 On which they stand; forth went thy current  
 fair,  
 And found them not  
 Old as the earth they seem, but thou wert old,  
 Ere man conceived their mould"

ILLUSTRATION FOR CHILDREN.—I once saw a clergyman trying to teach the children that the soul would live after they were all dead; they listened, but evidently did not understand. He was too abstract. Taking his watch from his pocket, he said,  
 "James, what is this that I hold in my hand?"

"A watch, sir."

"A little clock," says another.

"Do you see it?"

"Yes, sir."

"How do you know that it is a watch?"

"Because we see it, and hear it tick."

"Very good."

He then took off the case, and held it in one hand, and the watch in the other.

"Now, children, which is the watch? you see there are two which look like watches. Very well. Now I will lay the case aside—put it away down there in my hat. Now, let us see if you can hear the watch ticking?"

"Yes, sir, we hear it," exclaimed several voices.

"Well, the watch can tick, go, and keep time, as you see, when the case is taken off, and put in my hat, just as well. So it is with you, children. Your body is nothing but the case; the body may be taken off, and buried in the ground, and the soul will live, just as well as this watch will go, when the case is taken off."

## ADJUSTMENT OF THE CONSTITUTION OF PLANTS TO THE ANNUAL CYCLE.

It appears that the chilly nature of the season is not the only cause of the changes in the vegetable kingdom, which begin in autumn, and are consummated in winter. The disappearance of flowers and fruits, the fall of the leaf, and the general sterility which prevails, are evidently the indications of a cycle, belonging to the constitution of this department of nature, which corresponds with the cycle of the year, and affords by its existence, a new proof of wise adaptation. There is something exceedingly interesting and instructive in this view of the subject; and, were this inquiry to be followed out in detail, it could not fail to afford conclusive evidence of the same kind of contrivance with that to which we are now adverting. Everywhere we should find the productions of the soil admirably adapted to their localities, as to nourishment and climate; and in the physical distribution of plants, we should discover new grounds for adoring the perfections of the Creator. The most superficial comparison of the vegetation of tropical regions with that of the polar circle, would be sufficient for this purpose. In the diminutive *impetrum nigrum*, with its well-flavoured berries, which forms probably the last link of the descending chain of fruits in our progress to the poles, we observe the same careful adaptation of plants to the circumstances of external nature, which force themselves on our view in the majestic and luxuriant productions of the equator.

In the extremes of climate, taken on the average, we have, as it were, permanent summer, on the one hand, and permanent winter on the other: but in the temperate regions, we have a regular alternation of modified heat and cold, which requires a different constitution of the vegetable creation; and that constitution has been bestowed. We here find the gradual development of seeds, and shooting forth of buds and leaves, in spring; the vigour and prime of vegetation in summer; its maturity and commencing decay in autumn; its temporary death in winter. Now, what deserves to be peculiarly remarked in this, is the adjusted corre-



spondence of this annual revolution in plants, to the precise circumstances of the character and duration of the seasons.

That the stimulants of heat and cold exercise a considerable influence in promoting or retarding the periodical changes in the vegetable world, there can be no doubt; and this indeed is just one of those wise contrivances which indicate design, as, without this modifying power, a slight variation in the temperature of the season, such as frequently takes place in all countries, and especially in a changeable climate like ours, might be productive of fatal effects: but the influence of heat and cold does not extend beyond a certain range, and is undoubtedly controlled, as we have said, by another principle, which we have called the natural constitution of plants. If proof of this were wanting, we should find it in the fact, that fruit-trees, for example, when transplanted from our northern temperate zone to that of the south, where the seasons are reversed, continue to flourish for several years in the winter months of these regions; and, for the same reason, plants from the Cape of Good Hope, and from Australia, transplanted to our climate, preserve their accustomed period of blooming, notwithstanding the influence of an altered climate. Of this the heaths of those countries which bloom in the most rigorous season of our year, may be taken as a familiar example.

It appears, then, that the functions of plants have a periodical character, entirely independent of heat and cold. Such stimulants could not produce the effects which actually take place, were not the plants formed by the Author of Nature to run their annual cycle. Now, let it be observed, that a year might, by possibility, be of any length. Instead of extending to twelve months, it might be completed in six, and all the seasons might be comprised in that period; or its revolution might be lengthened to double or fourfold its present period. In either case, the adjustment which now takes place between the seasons and the constitution of plants, would be entirely destroyed, and an utter derangement of the vegetable world would take place.

"Now, such an adjustment," says Mr. Whewell, "must surely be accepted as a

proof of design exercised in the formation of the world. Why should the solar year be so long, and no longer? Or, this being of such a length, why should the vegetable cycle be exactly of the same length? Can this be chance? And this occurs, be it observed, not in one, or a few species of plants, but in thousands. Take a small portion only of known species, as the most obviously endowed with this adjustment,—say ten thousand. How should all these organised bodies be constructed for the same period of the year? How should all these machines be wound up, so as to go for the same time? Even allowing that they could bear a year of a month longer or shorter, how do they all come within such limits? No chance could produce such a result; and, if not by chance, how otherwise could such a coincidence occur, than by an intentional adjustment of these two things to one another?"

JEFFREY AND JOHN KEMBLE.—In February 1818, he did what he never did before, or since. He stuck a speech. John Kemble had taken his leave of our stage, and before quitting Edinburgh, about sixty or seventy of his admirers gave him a dinner and a snuff-box. Jeffrey was put into the chair, and had to make the address previous to the presentation. He began very promisingly, but got confused, and amazed both himself and everybody else, by actually sitting down and leaving the speech unfinished, and, until reminded of that part of his duty, not even thrusting the box into the hand of the intended receiver. He afterwards told me the reason of this. He had not premeditated the scene, and thought he had nothing to do except, in the name of the company, to give the box. But as soon as he rose to do this, Kemble, who was beside him, rose also, and with most formidable dignity. This forced Jeffrey to look up to his man, when he found himself annihilated by the tall tragic god, who sank him to the earth at every compliment by obeisances of overwhelming grace and stateliness. If the chairman had anticipated his position, or recovered from his first confusion, his mind and words could easily have subdued even Kemble.—*Cockburn's Life of Jeffrey.*

## OBSERVATIONS ON, AND RULES FOR, SKETCHING.

THE following hints, tending to further the tyro's progress in the delightful art of drawing, will not I trust prove unacceptable to such of your readers as are interested in the subject. For my own use I epitomized various directions relative to sketching, when I met with them in Gilpin's "Three Essays on Picturesque Beauty," and I shall feel particularly happy should my attempt at condensing much artistical matter from that interesting volume prove useful to the *amateur*; the *professor* undergoes a regular, severe, but *essential* course of study in that beautiful art, which is to purchase for him fame and emolument; but he who takes up his pencil merely for pastime, will do well to regulate its movements by a few *rules*, not cumbrous to the memory, and of easy application.

It is my intention briefly to state the object of Gilpin's first and second essays; from the third I have deduced those *rules* for *sketching* which appeared most obviously to result from the tenor of his observations:

Essay 1st discusses the difference between *actual* and *picturesque* beauty; *smoothness* is usually allowed to enter into our ideas of the former, but *roughness*, or *ruggedness* is decidedly *essential* to the latter: for example — The smooth shaven lawn, the neatly turned walk, the classic marble portico, &c., &c., are *beautiful*; but the ruined castle, the charmed mountain, the tempestuous ocean, &c., are *picturesque*, that is, with appropriate accompaniments; for, after remarking that the sublime and beautiful are, with many persons, the divisions of the *picturesque*, our acute observer of nature adds, "sublimity alone cannot make an object picturesque," it must in form, colour, or accompaniment, have some degree of *beauty* to render the epithet just. "Nothing can be more *sublime* than the ocean, but wholly unaccompanied it has little of the picturesque." It should also be remembered that objects of rough and careless contour, as the worn cart-horse, and the tattered beggar (neither of them laying claim to an iota of *sublimity*) please better in a painting, than

the sleekest racer, and the most finished belle of the "*Magazin des Modes*." \*

Essay 2nd treats of travelling, as far as it regards the *picturesque*, which is to be sought in natural, and sometimes in artificial, objects; these will constantly present themselves to the observer under all the varieties of light and shadow, and the different combinations of colour, form, and accompaniment, sometimes producing whole landscapes, but more frequently only beautiful parts of scenery. The *curious* and *fantastic* forms of nature are not subjects for the pencil, — and the draughtsman will endeavour to depict *animate* as well as *inanimate* objects. The utility and amusement of travelling are also considered in this essay, and hints thrown out for the improvement of barren and disagreeable country, by the observation of lights and shadows, tints of the season, distances, &c., with a recommendation to supply, if possible, every hiatus of nature, by the *imagination* of all that is needed to render her perfectly picturesque. (An ingenious idea; but, alas! mountains will not always rise in a marsh, forests wave over a sterile heath, nor lakes and rivers adorn a wheat-field. This essay, however, is worthy the perusal of travellers even, who never touched a pencil.)

Essay 3rd treats of sketching from nature, from whence are deduced the following instructive and interesting

#### Rules.

1. Every landscape should have a *leading subject*; a rule too much neglected even by superior artists.
2. Get the object, or subject you design to copy, into the *best* point of view.
3. Landscape consists of three general parts: — fore-ground, middle or second-ground, and distance; in sketching fore-ground, it is a good rule to have some

\* It is singular, but almost true to an axiom, that objects capable of exciting disgust in their *reality*, confer delight in their pictorial *representation*; the interior of some wretched hovel, a sty and its inmates, and a boorish revel, will exemplify this. Our pleasure in that case arises *perhaps* not from the objects represented, but from the *truth* of the *representation*. I know not that this paradox has ever been solved, and therefore with diffidence offer, that we are rather pleased with the *artist* than his *subject*.



part of it higher than the rest of the picture. (*Vide* Rule 7).

4. Mark the principal parts (or points) of your landscape on paper, that you may more readily ascertain the relative distances and situations of the others.

5. Pay attention to the *character* of your subject; mingle not trivial with grand details.

6. One landscape must not be crowded with circumstances sufficient for two or more.

7. It is sufficient to give the principal feature of what you essay to represent; as a castle, abbey, bridge, &c.; but its accompaniments may (and to *make* a picture, should) be often different. The *fore-ground* of a drawing *must* be the artist's own; and it should be ample, since an extended distance, and a narrow *fore-ground* is always awkward and bad in a picture.—N.B. Taste and observation will direct the student to select for his *fore-ground* clusters of trees, pieces of rock, or the fragments of ruined fabrics, &c., according to the nature of his subject.

8. On the accurate observation of *distances* the beauty of landscape depends; be careful therefore to get them correct at your outset, and to keep them so, by shading lightly with pen or brush your black-lead sketch (should the parts be complicated), whilst the view is before you, or fresh in your memory.

9. The hand should be accustomed to the touch of various kinds of trees, though in a mere *sketch*, little variety is required; the distinction, however, between full foliated, and straggling, branchy trees must be preserved, for both are necessary even in a sketch, and the artist should therefore be prepared to represent them.

10. The artist must attend to the *composition* and the disposition of his subject. By the *composition* may be understood the objects with which he composes his view; by the *disposition*, their picturesque and tasteful arrangement.

11. Figures, must be such as are appropriate to the scene; thus, history in miniature is bad, because a landscape is in itself a subject sufficient for the employment both of pencil and eye; therefore historical figures in a view, are lost and out of place.

12. Birds may be introduced with good effect, if thrown into proper distance; to represent them *near* is absurd: ruins and sea views are the best subjects in which they can appear.

13. *Effect* is to be produced best, by strong contrasts of *light* and *shade* both in earth and sky; but the student's taste must determine where these shall fall, and though the contrasts should be strong, yet *gradation*, in both, must be observed.

14. A predominancy of *shade* has the best effect; and light, though it should not be scattered, must not be drawn, as it were, into one focus.

15. The light, in a picture, is best disposed when the *fore-ground* is in shadow, and it falls in the middle; but this rule is subject to many variations. Light should rarely be spread on the distance.\*

16. It is useful to know, that the shadows of morning are darker than those of evening; also, that when objects are in *shadow*, their light (as it is then a reflected light) falls on the opposite side to that on which it would come if they were enlightened.

17. The *harmony* of the whole should be studied; if the piece strikes you as defective in this respect, place it at evening in some situation where it will not be reached by a strong light, when the misplaced lights and shadows will strike you more forcibly than in the glare of day.

18. To stain your paper with a slight reddish or yellowish tint, adds to the harmony of a sketch, yet it is a mere matter of taste; but, when it is desired, it had better be done after the drawing is completed, otherwise the colour risks looking patched from the rubber.†

19. In *colouring*, the *sky* gives the *ruling tint* to the landscape; it is absurd to unite a noonday sky, with a landscape of sunset glow.

20. From the three virgin colours, red,

\* Extraordinary and beautiful effects, however, are, by superior painters, frequently produced by violating this latter rule. The writer would particularly notice the results of light thrown into the distance, in stormy sea-views.

† Coffee has been recommended for this purpose, but delicate and pleasing washes or glazings may be produced from burnt sienna, yellow ochre, burnt umber, and lake, in various combinations, and laid on extremely attenuated by water.

blue, and yellow, all the tints of nature are composed.\* There is not in nature a perfect white, except snow, and the petals of some flowers.

21. Sketch nothing but what you can adorn, (for the purpose of showing to friends, &c.) but do not adorn your first, or *rough* sketch; make another, and refer to your *original* draught, as you would do to the view itself, for it contains your *general ideas*—your first and freshest, which may be lost by endeavouring to refine and improve upon them in the original sketch.†

22. In adorning your sketch, figures, both animate and inanimate, may be introduced, but *sparingly*; touch them slightly, for an attempt at *finish* offends.

I shall take the liberty of adding—endeavour to get a free and flowing outline; be not too minute either in detail or finishing; use pen or brush for your *rough* sketch in preference to pencil; you will gain confidence, and *correctness* will be your aim in your *adorned* copy. Finally, study nature, art, and good writers.

M. L. B.

**ACTION.**—The life of man can, in its true sense, consist only in constant active exertion, not only of the body, but also of the mental faculties. He is a stranger to happiness who passes his days in listless inactivity. That man can alone possess true joy, who devotes all the energies of his soul and body to one great specific end and aim; who lives for a great object, and strives with all the powers he can command to attain to the fulfilment of his wishes. Corporeal labour induces health of body, while no less so does mental effort promote the growth and increase the vigour of the mind.

\* The artist, however, cannot produce *his* tints from those simple colours *entirely*, but the advice once given to the writer, by a painter, was:—"Never fancy that *many* colours will effect your object, a few well chosen will better succeed, and be more easily managed; half-a-dozen would, for me, answer every purpose." The student is warned against *gaudy* colouring, which, if allowable in *caricatures* seen elsewhere, reminds one of pedlar's pictures.

† The old masters are well known to have made carefully *many* sketches of the subjects they designed for pictures, ere they dreamed of painting compositions that were to last for ever.

## ETIQUETTE.

THE covered hands might be considered as discourteous as a covered head; but why should uncovering either be a mark of respect? The solution of this question seems to me of some curiosity, and may perhaps be to many of your readers of some novelty. These, and most other modern forms of salutation and civility, are derived from chivalry, or at least from war, and they all betoken some deference, as from a conquered person to the conqueror; just as in private life we still continue to sign ourselves the "very humble servants" of our correspondents. The uncovered head was simply the head unarmed: the helmet being removed, the party was at mercy. So the hand being ungloved was the hand ungauntleted, and to this day it is an incivility to shake hands with gloves on. Shaking hands itself is but a token of truce, in which the parties took hold of each of the other's weapon-hand, to make sure against treachery. So also a gentleman's bow is but an offer of the neck to the stroke of the adversary; so that the lady's courtesy is but the form of going on her knees for mercy. This general principle is marked, as it ought naturally to be, still more strongly in the case of military salutes. Why is the discharge of guns a salute? Because it leaves the guns empty, and at the mercy of the opponent. And this is so true that the saluting with blank cartridge is a modern invention. Formerly salutes were fired by discharging the cannon balls, and there have been instances in which the compliment has been nearly fatal to the visitor whom it meant to honour. When the officer salutes he points his drawn sword to the ground; and the salute of the troops is, even at this day, called "presenting arms," that is, presenting them to be taken. There are several other details both of social and military salutations of all countries which might be produced; but I have said enough to indicate the principle.—*Notes and Queries.*

**FRIENDS.**—We ought always to make choice of persons of such worth and honour for our friends, that, if they should ever cease to be so, they will not abuse our confidence, nor give us cause to fear them as enemies.



## GALILEO.

GALILEO GALILEI was born at Florence, in Italy, in 1564. His father, Vincent Galilei, was a Florentine nobleman, and a man of talents. He designed his son to be a physician, and for a while young Galileo applied himself diligently to the study of medicine; but he was not satisfied with the medical profession, and finally his dislike for it becoming so great, his father consented that he might give it up.

He was fond of painting and music, but mathematics afforded him the greatest pleasure. After obtaining consent to lay aside the study of medicine, he pursued his favourite science with so much ardour, that at the age of twenty-four he was appointed mathematical professor at the University of Pisa, at that time one of the most celebrated institutions of learning in Italy.

His dislike to the philosophy of Aristotle made him so many enemies that he resigned the chair at Pisa in 1592, and accepted the professorship at the University of Padua. He remained in this place eighteen years. Cosmo III. at length invited him back to Pisa, and soon after called him to Florence, where he received the title of Principal Mathematician and Philosopher to the Grand Duke.

Galileo discovered the thermometer, an instrument by which we measure the degrees of heat and cold. In 1609, he heard of an instrument which had been constructed in Italy, that made objects seem larger and distant ones appear nearer. He immediately took two magnifying spectacle-glasses, and fitted one in each end of a leaden tube. On looking through it he discovered that objects appeared enlarged.

This instrument magnified only *three* times, yet simple as it was when compared with the telescope of the present day, he carried it to Venice, and presented it to the senate, where it excited great interest. He afterwards made another instrument, which magnified eight times, and at length one magnifying thirty times.

He now applied his large telescope to the heavenly bodies, and the result was the discovery of the four moons of Jupiter, the moon-like phases of Venus, the rings

of Saturn, the inequalities of the moon's surface, and also the starry-like nature of the Milky Way. His discoveries convinced him of the truthfulness of the Copernican system.

Soon after this, he made public his belief that the sun was the centre of the solar system, and that the earth moved around it and turned on its axis. On account of this belief he was persecuted by the Inquisition at Rome. The Pope and officers of the church of Rome which composed this Inquisition, believed that the doctrines of Galileo were contrary to the Bible; accordingly they decreed, in 1615, that he should renounce his sentiments, and neither teach nor publish them, or be cast into the prison. Thus compelled he renounced his belief.

For several years he remained silent on the subject, and the fears of the Inquisitors became quieted. But truth and science could not thus be long suppressed in the mind of Galileo. He longed to tell the world his views, and at length he published a dialogue, in which one person advocated the Copernican system, and another the Ptolemaic system—the one generally believed at that time. This enraged his enemies, and on the 14th of February, 1633, he was again summoned before the Inquisition at Rome, on the charge of heresy.

Previous to this Galileo had declared that, "Never will I barter the freedom of my intellect to one as liable to err as myself." But the time had now come to test his courage and resolution. For a few months he was allowed to remain in a secluded palace with a friend, but on the 21st of June, 1633, he was cited before the Inquisition.

Solemnly, and by an authority which it was fatal to resist, Galileo was called on to renounce a truth which nearly his whole life had been consecrated to reveal and maintain. This old and infirm philosopher they bade abjure and detest his own convictions and teachings, as false and heretical. His book they decreed to the flames, and condemned him for life to the dungeons of the Inquisition, bidding him recite, "once a week, the seven penitential psalms for the good of his soul!"

Did Galileo yield? Did he renounce what he *knew* to be true? Did he abjure

that theory, now universally received, affording such ample proof of the beauty and order of the universe? He was broken down by age and infirmity; his friends, more alarmed than himself, importuned him, and, kneeling on the ground, he pronounced and signed the following abjuration:

"With a sincere heart and unfeigned faith, I abjure, curse and detest said errors and heresies that the earth moves round the sun. I swear that I will never in future say or assert anything, verbally or in writing, which may give rise to a similar suspicion against me. I, Galileo Galilei, have abjured the above with my own hand."

His indignation was so great, and his conviction of the truthfulness of his doctrine so strong, that, as he arose from his knees, he stamped upon the ground and whispered to a friend, "*It does move, though!*" Ay, and in spite of the Inquisition it has gone round for centuries since; nay, the whole world of thought itself has moved on and on, and by the impulses of such minds will continue to revolve for ages in a glorious cycle for mankind.

When Galileo had signed his abjuration he was sent to prison and confined for several years, after which he was permitted to retire to his home in Florence, upon the condition that he would not leave his house, nor receive visits from his friends. Though he was removed from the prison of the Inquisition, they made a prison of his own home.

Notwithstanding he was thus doomed to be for ever shut up from communication with great minds, and from social intercourse with his friends, yet the way from Rome to Florence seemed long, and the fleetest travelling all too slow. There was yet left to him one being from whom he could receive words of consolation—it was his affectionate child, Maria Galilei. To her his heart clung with more than fondness.

Galileo longed once more to fold her to his heart; and she, too, anticipated meeting her father with a pleasure greater than ever before enjoyed, since he had become, in her eyes, a sainted victim, by the persecution he had suffered. But alas! this source of happiness was soon blighted. Within one short month after his return,

the fond daughter died, and his home was then indeed a prison to him.

There came yet another trial: for three years before his death he was totally blind; yet he did not despair. Like Milton, he laboured on for mankind, still pursuing his scientific studies. He bore all his misfortunes with patience. "Never," said Galileo, "never will I cease to use the senses which God has left me; and though this heaven, this earth, this universe be henceforth shrunk for me into the narrow space which I myself fill, so it please God it shall content me."

He died January 8, 1642, at seventy-eight years of age. Such was the malice of his enemies that his right to make a will was disputed, and he was denied a burial in consecrated ground, also a monument, for which large sums had been subscribed. But his remains have been re-interred, and a splendid monument since erected to his memory.

Little more than two hundred years have passed since the death of Galileo, but ample justice has been done his memory. His name will be a watchword through all time to urge men forward in the great cause of moral and intellectual progress; and the tree of knowledge, whose fruits were once on earth, plucked, perhaps, ere they were matured, has shot up with its golden branches into the skies, over which has radiated the smiles of a beneficent Providence, to cheer man onward in the career of virtue and intelligence.

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THE SEA.—The sea is the largest of all cemeteries, and its slumberers sleep without monuments. All other graveyards, in all other lands, show some symbol of distinction between the great and small, the rich and poor; but in that ocean cemetery the king and the clown, the prince and the peasant, are alike distinguished. The same waves roll over all—the same requiem by the minstrelsy of the ocean is sung to their honour. Over their remains the same storm beats, and the same sun shines, and there unmarked the weak and the powerful, the plumed and the unhonoured, will sleep on until awakened by the same trump, when the sea shall give up its dead.



## THE RIGHT EDUCATION OF CHILDREN.

To the reflecting mind it must appear strange that, at this advanced age of civilization, the proper manner of educating the young and fitting them for future usefulness, is so imperfectly understood.

The parent naturally seeks the elevation of his children both in a moral and a social point of view. And to him nothing can be more pleasing than the thought that at some future time the seeds of instruction which he is now implanting in the youthful minds of his children will spring up and bear fruit abundantly; and that his offspring will yet occupy such a position in society as will reflect credit upon their parents, and do honour to themselves.

All this is perfectly in keeping with the laws of nature, but the means employed for the attainment of the desired object are in most cases such that the hopes of the parent are only realized at the expense of the child's health, and not unfrequently at the price of his life. These latter considerations, however, are only applicable to those youths in whom there seems to be implanted a natural thirst after knowledge.

Such a child, if he apply himself closely to his studies, and take little or no physical exercise, must keep his mind in continual exercise; consequently there is more blood sent to the brain than it actually requires, and more than to any other one organ in his body. Even though he might become a prodigy, it is to be feared that he cannot survive long without a thorough reformation in regard to his manner of study.

It is the case with too many parents, when they see one of their children more fond of his books than another, to encourage him to go on in the pursuit of knowledge and stimulate him to undertake the mastery of even more difficult studies than he had before attempted. Hence their beloved son, instead of inhaling the pure air of heaven, is continually tied down to his books—study, study, study, nothing but study.

Ah, parent! Dost thou not see the pale face and emaciated form of thy son? He is already worn out with the over-exertion of

his intellect. And because he has a natural desire for the attainment of knowledge a constant craving after more, and yet more, will you still urge him to press forward in the hope of seeing him at length mount to the very summit of the hill of science? Will you encourage him to devote his every moment to the attainment of learning, even at the sacrifice of health? Nay, give him healthful exercise; let his physical, as well as his mental powers have full, free, and vigorous exercise.

Oh, that the time may soon come, when parents will begin to feel the necessity of seeing that their children are properly educated, without endangering their health.

Dr. Wieting mentions the case of a lad, about seven years of age, who could solve a mathematical problem which many at a far more advanced age, and much higher pretensions, would attempt in vain. His parent loved him as a good parent ever will regard his offspring, and urged him, or rather encouraged him in applying himself closely to his studies,—so much so, that he took little or no physical exercise.

And what was the consequence? Thus over-exerted, his brain received a greater quantity of blood than it required and soon became diseased, which terminated the life of the child in his eighth year. His parents literally killed him with kindness. Thus the very means made use of with the design of promoting his happiness proved the loss of his life.

Such a child, rightly educated, might have become an ornament to his family, and a blessing to his country. Had his mental and physical powers been exercised in the right proportions, he might have now been the joy of his parents.

Will parents ever feel the necessity of looking to the real interest of their children? Let daily exercise become an essential part of the education of children; then the thin face and the emaciated figure shall give place to the hale, hearty, and robust form, blending a vigorous intellect with a good and healthy constitution.

Such a scholar will not be likely to die in the morning of youth, but may live to be respected and useful, and would undoubtedly be the means of exerting an influence for good which would be widely felt wherever he might be placed.

## THE ATMOSPHERE AS A LENS.

THE largest lens upon which we have any opportunities of making observations, is the atmosphere; but as, even in its pure state, it is not an achromatic lens, our observations of it are far from perfect. Still, the atmosphere is a very curious lens; and the changes that it produces on the appearances of light, and of visible objects, both in consequence of the state of the different parts of itself, of the various matters it contains, and of the numerous changes which these undergo,—together with its being the immediate element in which we live, make all our observations, and perform all our operations,—render it a most interesting subject of study.

This is not the proper place for saying very much respecting it; but as it is from the atmosphere that we get much of our light upon all occasions, and the whole of it when clouds hide the luminaries, the mere outlines of the doctrine of light are incomplete without it.

Taken in itself, and without any allusion to disturbing causes, the atmosphere is a transparent shell of matter, which rapidly becomes rarer as we ascend above the mean level of the earth's surface. The diminution of density as we ascend is gradual; so that, unless from winds, clouds, or other foreign causes, there are no fixed lines, or boundaries, of stratum and stratum in it, as there are in the cases of those media which we have been considering. We cannot even define its upper limit, or the limit at which it begins to be so dense as to refract light in visible quantity; for they both vary with the state of the weather. It follows the general law, however; and when equally clear, the densest portions of it reflect the most light, and refract it at the greatest angle. They do so toward the perpendicular; which, when we look toward the sky, is the axis of the eye, or the line joining the centre of the pupil of the eye and that of the object we look at. In consequence of this, when we see the sun or the moon through the dense air near the horizon, and bear in mind that we are not in the centre of the atmospheric shell but distant from it by the radius of the earth, or nearly 4,000 miles, and probably less than 100 from the point at which it first begins to refract light, we can easily understand

why the luminary should *appear* much larger there than when it is near the zenith.

The refractory power of air, even at the surface density, is very small; and so the refracted light which comes to us in dawn, and lingers with us in twilight, must bend down to us in exceeding gentle curves,—curves which advance hundreds of miles before they are sensibly deflected from the straight line. But still that makes the effect greater in the end than if the atmosphere were of uniform density, and the entire refraction took place at that height where it begins. The whole of the refracted ray has been stated as appearing to the observer to come in the direction of the part next his eye; and therefore the refractive ray of the luminaries, and the refractive magnifying of their discs, when near the horizon, are greater than if the light came from the upper part of the atmosphere in straight lines.

The very same causes explain why the dome of the heavens over us appears flattened, while the diminished luminaries seem clearer than when they are lower down. The haze and fog which are always in the atmosphere near the horizon, help to increase the effect. It is often too confidently said, that we judge of the magnitude of objects solely from the visual angles under which they are seen. But there are many elements in our judgment of visible magnitude; and any one who has been in the habit of viewing objects in fogs—whether the dense and palpable fogs, or the half-seen ones which often load the horizon—must in many instances have found the fog to magnify every object seen through it, very much in proportion to the obscurity with which it was seen, and at the same time apparently remove it to a much greater distance.

The atmosphere partakes of the imperfection of the lens in colouring toward the extremities. There is no doubt that the gay colours of the morning and the evening are owing to the greater refractive power of the denser strata of atmosphere through which the slanting beams of the sun pass at those times; and as, when the atmosphere has much evaporative power, and the weather is settled to be fine, there is much humidity remaining aloft in the evening sky, the rich succession of colours at such times is easily accounted for.



# POPULAR ASTRONOMY.

## LETTER VII.

### ANNUAL REVOLUTION.—SEASONS.

“ These, as they change, Almighty Father, these  
Are but the varied God. The rolling year  
Is full of Thee.”—*Thomson*.

WE have seen that the apparent revolution of the heavenly bodies, from east to west, every twenty-four hours, is owing to a real revolution of the earth on its own axis, in the opposite direction. This motion is very easily understood, resembling, as it does, the spinning of a top. We must, however, conceive of the top as turning without any visible support, and not as resting in the usual manner on a plane. The annual motion of the earth around the sun, which gives rise to an apparent motion of the sun around the earth once a year, and occasions the change of seasons, is somewhat more difficult to understand; and it may cost you some reflection, before you will settle all the points respecting the changes of the seasons clearly in your mind. We sometimes see these two motions exemplified in a top. When, as the string is pulled, the top is thrown forwards on the floor, we may see it move forward (sometimes in a circle) at the same time that it spins on its axis. Let a candle be placed on a table, to represent the sun, and let these two motions be imagined to be given to a top around it, and we shall have a case somewhat resembling the actual motions of the earth around the sun.

When bodies are at such a distance from each other as the earth and the sun, a spectator on either would project the other body upon the concave sphere of the heavens, always seeing it on the opposite side of a great circle one hundred and eighty degrees from himself.

Recollect that the path in which the earth moves round the sun is called the ecliptic. We are not to conceive of this, or of any other celestial circle, as having any real, palpable existence, any more than the path of a bird through the sky. You will perhaps think it quite superfluous for me to remind you of this; but, from the habit of seeing the orbits of the heavenly bodies represented in diagrams and orreries, by palpable lines and circles, we are apt inadvertently to acquire the notion, that the orbits of the planets, and other representations of the artificial sphere, have a real, palpable existence in Nature; whereas, they denote the places where mere geometrical or imaginary lines run. You might have expected to see an orrery, exhibiting a view of the sun and planets, with their various motions, particularly described in my Letter on astronomical instruments and apparatus. I must acknowledge, that I entertain a very low opinion of the utility of even the best orreries, and I cannot recommend them as auxiliaries in the study of astronomy. The numerous appendages usually connected with them, some to support them in a proper position, and some to communicate to them the requisite motions, enter into the ideas which the learner forms respecting the machinery of the heavens; and it costs much labour afterwards to divest the mind of such erroneous impressions. Astronomy can be exhibited much more clearly and beautifully to the mental eye than to the visual organ. It is much easier to conceive of the sun existing in boundless space, and of the earth as moving around him at a great distance, the mind having nothing in view but simply these two bodies, than it is, in an orrery, to contemplate the motion of a ball representing the earth, carried by a complicated apparatus of wheels around another ball, supported by a cylinder or wire, to represent the sun. I would advise you, whenever it is practicable, to think how things are in Nature, rather than how they are represented by Art. The machinery of the heavens is much simpler than that of an orrery.

In endeavouring to obtain a clear idea of the revolution of the earth around the sun, imagine to yourself a plane (a geometrical plane, having merely length and breadth, but no thickness) passing through the centres of the sun and the earth, and extended

far beyond the earth till it reaches the firmament of stars. Although, indeed, no such dome actually exists as that under which we figure to ourselves the vault of the sky, yet, as the fixed stars appear to be set in such a dome, we may imagine that the circles of the sphere, when indefinitely enlarged, finally reach such an imaginary vault. All that is essential is, that we should imagine this to exist far beyond the bounds of the solar system, the various bodies that compose the latter being situated close around the sun, at the centre.

Along the line where this great circle meets the starry vault, are situated a series of

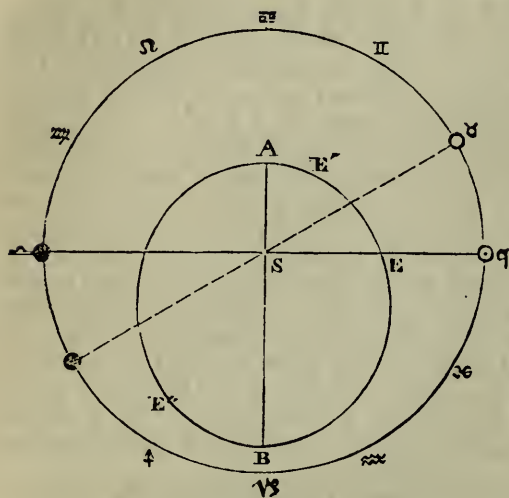


Fig. 25.

constellations,—Aries, Taurus, Gemini, &c.,—which occupy successively this portion of the heavens. When bodies are at such a distance from each other as the sun and the earth, I have said that a spectator on either would project the other body upon the concave sphere of the heavens, always seeing it on the opposite side of a great circle one hundred and eighty degrees from himself. The place of a body, when viewed from any point, is denoted by the position it occupies among the stars. Thus, in the diagram, fig. 25, when the earth arrives at E, it is said to be in Aries, because, if viewed from the sun, it would be projected on that part of the heavens; and, for the same reason, to a spectator at E, the sun would be in Libra. When the earth shifts its position from Aries to Taurus, as we are unconscious of our own motion, it is the sun that appears

to move from Libra to Scorpio, in the opposite part of the heavens. Hence, as we go forward, in the order of the signs, on one side of the ecliptic, the sun seems to be moving forward at the same rate on the opposite side of the same great circle; and therefore, although we are unconscious of our own motion, we can read it, from day to day, in the motions of the sun. If we could see the stars at the same time with the sun, we could actually observe, from day to day, the sun's progress through them, as we observe the progress of the moon at night; only the sun's rate of motion would be nearly fourteen times slower than that of the moon. Although we do not see the stars when the sun is present, we can observe that it makes daily progress eastward, as is apparent from the constellations of the zodiac occupying, successively, the western sky immediately after sunset, proving that either all the stars have a common motion westward, independent of their diurnal motion, or that the sun has a motion past them from west to east. We shall see, hereafter, abundant evidence to prove, that this change in the relative position of the sun and stars is owing to a change in the apparent place of the sun, and not to any change in the stars.

To form a clear idea of the two motions of the earth, imagine yourself standing on a circular platform which turns slowly round its centre. While you are carried slowly round the entire of the circuit of the heavens, along with the platform, you may turn round upon your heel the same way three hundred and sixty-five times. The former is analogous to our annual motion with the earth around the sun; the latter, to our diurnal revolution in common with the earth around its own axis.

Although the apparent revolution of the sun is in a direction opposite to the real motion of the earth, as regards absolute space, yet both are nevertheless from west to east, since these terms do not refer to any directions in absolute space, but to the order in which certain constellations (the constellations of the Zodiac) succeed one another. The earth itself, on opposite sides of its orbit, does in fact move towards directly opposite points of space; but it is all the while pursuing its course in the



order of the signs. In the same manner, although the earth turns on its axis from west to east, yet any place on the surface of the earth is moving in a direction in space exactly opposite to its direction twelve hours before. If the sun left a visible trace on the face of the sky, the ecliptic would of course be distinctly marked on the celestial sphere, as it is on an artificial globe; and were the equator delineated in a similar manner, we should then see, at a glance, the relative position of these two circles,—the points where they intersect one another, constituting the equinoxes, the points where they are at the greatest distance asunder, that is, the solstices; and various other particulars, which, for want of such visible traces, we are now obliged to search for by indirect and circuitous methods. It will aid you, to have constantly before your mental vision an imaginary delineation of these two important circles on the face of the sky.

The equator makes an angle with the ecliptic of twenty-three degrees and twenty-eight minutes. This is called the obliquity of the ecliptic. As the sun and earth are both always in the ecliptic, and as the motion of the earth in one part of it makes the sun appear to move in the opposite part, at the same rate, the sun apparently descends, in Winter, twenty-three degrees and twenty-eight minutes to the south of the equator, and ascends, in Summer, the same number of degrees north of it. We must keep in mind, that the celestial equator and celestial ecliptic are here understood, and we may imagine them to be two great circles delineated on the face of the sky. On comparing observations made at different periods, for more than 2,000 years, it is found, that the obliquity of the ecliptic is not constant, but that it undergoes a slight diminution, from age to age, amounting to fifty-two seconds in a century, or about half a second annually. We might apprehend that, by successive approaches to each other, the equator and ecliptic would finally coincide; but astronomers have discovered, by a most profound investigation, based on the principles of universal gravitation, that this irregularity is confined within certain narrow limits; and that the obliquity, after diminishing for some thousands of years, will then increase for a similar period, and will thus vibrate for ever about a mean value.

As the earth traverses every part of her orbit in the course of a year, she will be once at each solstice, and once at each equinox. The best way of obtaining a correct idea of her two motions is, to conceive of her as standing still for a single day, at some point in her orbit, until she has turned once on her axis, then moving about a degree, and halting again, until another diurnal revolution is completed. Let us suppose the earth at the Autumnal equinox, the sun, of course, being at the Vernal equinox,—for we must always think of these two bodies as diametrically opposite to each other. Suppose the earth to stand still in its orbit for twenty-four hours. The revolution of the earth on its axis, from west to east, will make the sun appear to describe a great circle of the heavens from east to west, coinciding with the equator. At the end of this period, suppose the sun to move northward one degree, and to remain there for twenty-four hours; in which time, the revolution of the earth will make the sun appear to describe another circle, from east to west, parallel to the equator, but one degree north of it. Thus, we may conceive of the sun as moving one degree north, every day, for about three months, when it will reach the point of the ecliptic furthest from the equator, which point is called the *tropic*, from a Greek word, signifying *to turn*; because, after the sun has passed this point, his motion in his orbit carries him continually towards the equator, and therefore he seems to turn about. The same point is also called the *solstice*, from a Latin word signifying to *stand still*; since, when the sun has reached its greatest northern or southern limit, while its declination is at the point where it ceases to increase, but begins to decrease, there the sun seems for a short time stationary, with regard to the equator, appearing for several days to describe the same parallel of latitude.

When the sun is at the northern tropic, which happens about the twenty-first of June, his elevation above the southern horizon at noon is the greatest in the year; and when he is at the southern tropic, about the twenty-first of December, his elevation at noon is the least in the year. The difference between these two meridian altitudes will give

the whole distance from one tropic to the other, and consequently, twice the distance from each tropic to the equator. By this means, we find how far the tropic is from the equator, and that gives us the angle which the equator and ecliptic make with each other; for the greatest distance between any of two great circles on the sphere is always equal to the angle which they make with each other. Thus, the ancient astronomers were able to determine the obliquity of the ecliptic with a great degree of accuracy. It was easy to find the situation of the zenith, because the direction of a plumb-line shows us where that is; and it was easy to find the distances from the zenith where the sun was at the greatest and least distances, respectively. The difference

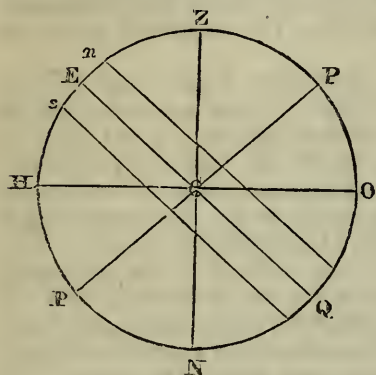


Fig. 26.

of these two arcs is the angular distance from one tropic to the other; and half this arc is the distance of either tropic from the equator, and of course equal to the obliquity of the ecliptic. All this will be very easily understood from the annexed diagram (Fig. 26). Let Z be the zenith of a spectator situated at C; Z $n$  the least, and Z $s$  the greatest distance of the sun from the zenith. From Z $s$  subtract Z $n$ , and then  $sn$ , the difference, divided by two, will give the obliquity of the ecliptic.

The motion of the earth in its orbit is nearly seventy times as great as its greatest motion around its axis. In its revolution around the sun, the earth moves no less than one million six hundred and forty thousand miles per day, sixty-eight thousand miles per hour, eleven hundred miles per minute, and nearly nineteen miles every second; a velocity nearly sixty times as great as the greatest velocity of a cannon ball. Places on the earth turn with very different degrees of velocity in different latitudes. Those near the equator are carried round on the circumference of a large circle; those towards the poles, on the circumference of a small circle; while one standing on the pole itself would not turn at all. Those who live on the equator are carried about one thousand miles an hour. In our latitude (forty-one degrees and eighteen minutes), the diurnal velocity is about seven hundred and fifty miles per hour. It would seem, at first view, quite incredible, that we should be whirled round at so rapid a rate, and yet be entirely insensible of any motion; and, much more, that we could be going so swiftly through space, in our circuit around the sun, while all things, when unaffected by local causes, appear to be in such a state of quiescence. Yet we have the most unquestionable evidence of the fact; nor is it difficult to account for it, in consistency with the general state of repose among bodies on the earth, when we reflect that their relative motions, with respect to each other, are not in the least disturbed by any motions which they may have in common. When we are on board a steamboat, we move about in the same manner, when the boat is in rapid motion, as when it is lying still; and such would be the case, if it moved steadily a hundred times faster than it does. Were the earth, however, suddenly to stop its diurnal revolution, all moveable bodies on its surface would be thrown off in tangents to the surface with velocities proportional to that of their diurnal motion; and were the earth suddenly to halt in its orbit, we should be hurled forward into space with inconceivable rapidity.

I will next endeavour to explain to you the phenomena of the *Seasons*. These depend on two causes; first, the inclination of the earth's axis to the plane of its orbit; and, secondly, to the circumstance, that the axis always remains parallel to itself. Imagine to yourself a candle placed in the centre of a ring, to represent the sun in the centre of the earth's orbit, and an apple with a knitting-needle running through it in the direction of the stem. Run a knife around the central part of the apple, to mark the situation of the equator. The circumference of the ring represents the earth's orbit in the plane of the ecliptic. Place the apple so that the equator shall coincide with the wire; then the axis will lie directly across the plane of the ecliptic; that is, at right angles to



it. Let the apple be carried quite round the ring, constantly preserving the axis parallel to itself, and the equator all the while coinciding with the wire that represents the orbit. Now, since the sun enlightens half the globe at once, so the candle, which here represents the sun, will shine on the half of the apple that is turned towards it; and the circle which divides the enlightened from the unenlightened side of the apple, called the *terminator*, will pass through both the poles. If the apple be turned slowly round on its axis, the terminator will successively pass over all places on the earth, giving the appearance of sunrise to places at which it arrives, and of sunset to places from which it departs. If, therefore, the equator had coincided with the ecliptic, as would have been the case, had the earth's axis been perpendicular to the plane of its orbit, the diurnal motion of the sun would always have been in the equator, and the days and nights would have been equal all over the globe. To the inhabitants of the equatorial parts of the earth, the sun would always have appeared to move in the prime vertical, rising directly in the east, passing through the zenith at noon, and setting in the west. In the polar regions, the sun would always have appeared to revolve in the horizon; while, at any place between the equator and the pole, the course of the sun would have been oblique to the horizon, but always oblique in the same degree. There would have been nothing of those agreeable vicissitudes of the seasons which we now enjoy; but some regions of the earth would have been crowned with perpetual spring, others would have been scorched with the unremitting fervour of a vertical sun, while extensive regions towards either pole would have been consigned to everlasting frost and sterility.

To understand, then, clearly, the causes of the change of seasons, use the same apparatus as before; but, instead of placing the axis of the earth at right angles to the plane of its orbit, turn it out of a perpendicular position a little (twenty-three degrees and twenty-eight minutes), then the equator will be turned just the same number of degrees out of a coincidence with the ecliptic. Let the apple be carried around the ring, always holding the axis inclined at the same angle to the plane of the ring, and always parallel to itself. You will find that there will be two points in the circuit where the plane of the equator, that you had marked around the centre of the apple, will pass through the centre of the sun; these will be the points where the celestial equator and the ecliptic cut one another, or the equinoxes. When the earth is at either of these points, the sun shines on both poles alike; and, if we conceive of the earth, while in this situation, as turning once round on its axis, the apparent diurnal motion of the sun will be the same as it would be, were the earth's axis perpendicular to the plane of the equator. For that day, the sun would revolve in the equator, and the days and nights would be equal all over the globe. If the apple were carried round in the manner supposed, then, at the distance of ninety degrees from the equinoxes, the same pole would be turned from the sun on one side, just as much as it was turned towards him on the other. In the former case, the sun's light would fall short of the pole twenty-three and a half degrees, and in the other case, it would reach beyond it the same number of degrees. I would recommend to you to obtain as clear an idea as you can of the cause of the change of seasons, by thinking over the following illustration. You may then clear up any remaining difficulties, by studying the diagram.

Let A B C D represent the earth's place in different parts of its orbit, having the sun in the centre. Let A, C, be the positions of the earth at the equinoxes, and B, D, its positions at the tropics,—the axis *ns* being always parallel to itself. It is difficult to represent things of this kind correctly, all on the same plane; but you will readily see, that the figure of the earth, here, answers to the apple in the former illustration; that the hemisphere towards *n* is above, and that towards *s* is below, the plane of the paper. When the earth is at A and C, the Vernal and Autumnal equinoxes, the sun, you will perceive, shines on both the poles *n* and *s*; and, if you conceive of the globe, while in this position, as turned round on its axis, as it is in the diurnal revolution, you will readily understand, that the sun would describe the celestial equator. This may not at first appear so obvious, by inspecting the figure; but if you consider the point *n* as raised above the plane of the paper, and the point *s* as depressed below it, you will readily see how the plane of the equator would pass through the centre of the sun.

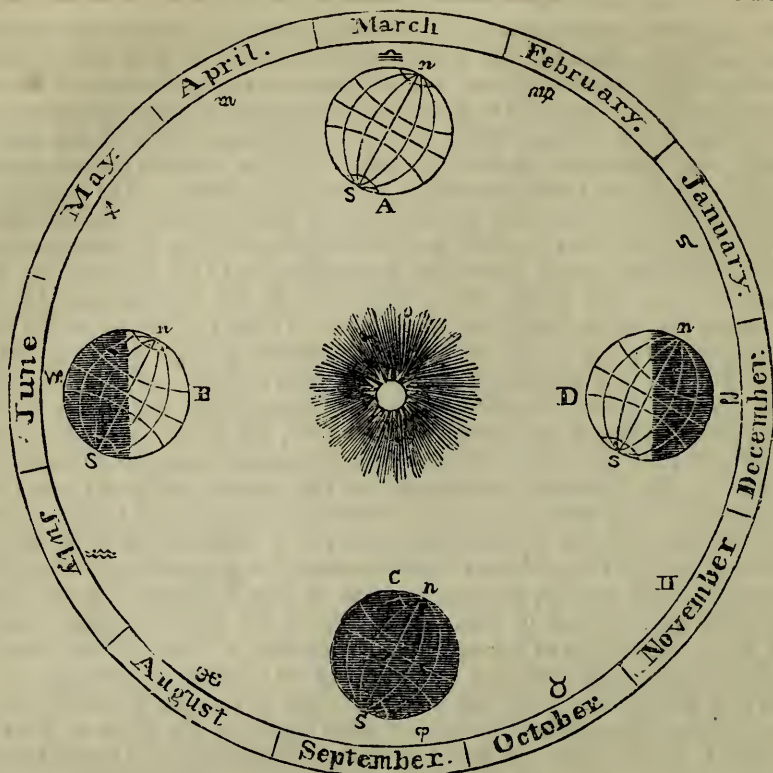


Fig. 27.

Again; at B, when the earth is at the southern tropic, the sun shines at twenty-three and a half degrees beyond the north pole, *n*, and falls the same distance short of the south pole, *s*. The case is exactly reversed when the earth is at the northern tropic, and the sun at the southern. While the earth is at one of the tropics, at B, for example, let us conceive of it as turning on its axis, and we shall readily see, that all that part of the earth which lies within the north polar circle will enjoy continual day, while that within the south polar circle will have continual night; and that all other places will have their days longer as they are nearer to the enlightened pole, and shorter as they are nearer to the unenlightened pole. This figure likewise shows the successive positions of the earth, at different periods of the year, with respect to the signs, and what months correspond to particular signs. Thus, the earth enters Libra, and the sun Aries, on the twenty-first of March, and on the twenty-first of June the earth is just entering Capricorn, and the sun, Cancer. You will call to mind what is meant by this phraseology,—that by saying the earth enters Libra, we mean that a spectator placed on the sun would see the earth in that part of the celestial ecliptic, which is occupied by the sign Libra; and that a spectator on the earth sees the sun at the same time projected on the opposite part of the heavens, occupied by the sign Cancer.

Had the axis of the earth been perpendicular to the plane of the ecliptic, then the sun would always have appeared to move in the equator, the days would everywhere have been equal to the nights, and there could have been no change of seasons. On the other hand, had the inclination of the ecliptic to the equator been much greater than it is, the vicissitudes of the seasons would have been proportionally greater than at present. Suppose, for instance, the equator had been at right angles to the ecliptic,—in which case, the poles of the earth would have been situated in the ecliptic itself; then, in different parts of the earth, the appearances would have been as follows:—To a spectator on the *equator* (where all the circles of diurnal revolution



are perpendicular to the horizon,) the sun, as he left the vernal equinox, would every day perform his diurnal revolution in a smaller and smaller circle, until he reached the north pole, when he would halt for a moment, and then wheel about and return to the equator, in a reverse order. The progress of the sun through the southern signs, to the south pole, would be similar to that already described. Such would be the appearances to an inhabitant of the equatorial regions. To a spectator living in an *oblique* sphere, in our own latitude, for example, the sun, while north of the equator, would advance continually northward, making his diurnal circuit in parallels further and further distant from the equator, until he reached the circle of perpetual apparition; after which, he would climb, by a spiral course, to the north star, and then as rapidly return to the equator. By a similar progress southward, the sun would at length pass the circle of perpetual occultation, and for some time (which would be longer or shorter, according to the latitude of the place of observation) there would be continual night. To a spectator on the *pole* of the earth and under the pole of the heaven, during the long day of six months, the sun would wind its way to a point directly over head, pouring down upon the earth beneath not merely the heat of the torrid zone, but the heat of a torrid noon, accumulating without intermission.

The great vicissitudes of heat and cold, which would attend these several movements of the sun, would be wholly incompatible with the existence of either the animal or the vegetable kingdom, and all terrestrial Nature would be doomed to perpetual sterility and desolation. The happy provision which the Creator has made against such extreme vicissitudes, by confining the changes of the seasons within such narrow bounds, conspires with many other express arrangements in the economy of Nature, to secure the safety and comfort of the human race.

Perhaps you have never reflected upon all the reasons why the several changes of position, with respect to the horizon, which the sun undergoes in the course of the year, occasion such a difference in the amount of heat received from him. Two causes contribute to increase the heat of Summer and the cold of Winter. The higher the sun ascends above the horizon, the more directly his rays fall upon the earth; and their heating power is rapidly augmented, as they approach a perpendicular direction. When the sun is nearly over head, his rays strike us with far greater force than when they meet us obliquely; and the earth absorbs a far greater number of those rays of heat which strike it perpendicularly, than of those which meet it in a slanting direction. When the sun is near the horizon, his rays merely glance along the ground, and many of them, before they reach it, are absorbed and dispersed in passing through the atmosphere. Those who have felt only the oblique solar rays, as they fall upon objects in the high latitudes, have a very inadequate idea of the power of a vertical, noonday sun, as felt in the region of the equator.

The increased length of the day in Summer is another cause of the heat of this season of the year. This cause more sensibly affects places far removed from the equator, because at such places the days are longer and the nights shorter than in the torrid zone. By the operation of this cause, the solar heat accumulates there so much, during the longest days of summer, that the temperature rises to a higher degree than is often known in the torrid climates.

But the temperature of a place is influenced very much by several other causes, as well as by the force and duration of the sun's heat. First, the *elevation* of a country above the level of the sea has a great influence upon its climate. Elevated districts of country, even in the torrid zone, often enjoy the most agreeable climate in the world. The cold of the upper regions of the atmosphere modifies and tempers the solar heat, so as to give a most delightful softness, while the uniformity of temperature excludes those sudden and excessive changes which are often experienced in less favoured climes. In ascending certain high mountains situated within the torrid zone, the traveller passes, in a short time, through every variety of climate, from the most oppressive and sultry heat, to the soft and balmy air of Spring, which again is succeeded by the cooler breezes of Autumn, and then by the severest frosts of Winter. A corresponding difference is seen in the products of the vegetable kingdom. While

Winter reigns on the summit of the mountain, its central regions may be encircled with the verdure of Spring, and its base with the flowers and fruits of Summer. Secondly, the proximity of the *ocean* also has a great effect to equalize the temperature of a place. As the ocean changes its temperature during the year much less than the land, it becomes a source of warmth to contiguous countries in Winter, and a fountain of cool breezes in Summer. Thirdly, the relative *humidity* or *dryness* of the atmosphere of a place is of great importance, in regard to its effects on the animal system. A dry air of ninety degrees is not so insupportable as a humid air of eighty degrees; and it may be asserted as a general principle, that a hot and humid atmosphere is unhealthy, although a hot air, when dry, may be very salubrious. In a warm atmosphere which is dry, the evaporation of moisture from the surface of the body is rapid, and its cooling influence affords a most striking relief to an intense heat without; but when the surrounding atmosphere is already filled with moisture, no such evaporation takes place from the surface of the skin, and no such refreshing effects are experienced from this cause. Moisture collects on the skin; a sultry, oppressive sensation is felt; and chills and fevers are usually in the train.

## LETTER VIII.

### LAWS OF MOTION.

"What though in solemn silence, all  
Move round this dark, terrestrial ball!  
In reason's ear they all rejoice,  
And utter forth a glorious voice;  
For ever singing, as they shine,  
'The hand that made us is Divine.'"—Addison.

HOWEVER incredible it may seem, no fact is more certain, than that the earth is constantly on the wing, flying around the sun with a velocity so prodigious, that, for every breath we draw, we advance on our way forty or fifty miles. If, when passing across the waters in a steam-boat, we can wake, after a night's repose, and find ourselves conducted on our voyage a hundred miles, we exult in the triumphs of art, which could have moved so ponderous a body as a steam-ship over such a space in so short a time, and so quietly, too, as not to disturb our slumbers; but, with a motion vastly more quiet and uniform, we have, in the same interval, been carried along with the earth in its orbit more than half a million of miles. In the case of the steam-ship, however perfect the machinery may be, we still, in our waking hours at least, are made sensible of the action of the forces by which the motion is maintained,—as the roaring of the fire, the beating of the piston, and the dashing of the paddle-wheels; but in the more perfect machinery which carries the earth forward on her grander voyage, no sound is heard, nor the least intimation afforded of the stupendous forces by which this motion is achieved. To the pious observer of Nature it might seem sufficient, without any inquiry into second causes, to ascribe the motions of the spheres to the direct agency of the Supreme Being. If, however, we can succeed in finding the secret springs and cords, by which the motions of the heavenly bodies are immediately produced and controlled, it will detract nothing from our just admiration of the Great First Cause of all things. We may therefore now enter upon the inquiry into the nature or laws of the forces by which the earth is made to revolve on her axis and in her orbit; and having learned what it is that causes and maintains the motions of the earth, you will then acquire, at the same time, a knowledge of all the celestial machinery. The subject will involve an explanation of the laws of motion, and of the principles of universal gravitation.

It was once supposed that we could never reason respecting the laws that govern the heavenly bodies from what we observe in bodies around us, but that motion is one thing on the earth, and quite another thing in the skies; and, hence, that it is impossible for us, by any inquiries into the laws of terrestrial nature, to ascertain how things take place among the heavenly bodies. Galileo and Newton, however, pro-



ceeded on the contrary supposition, that Nature is uniform in all her works; that the same Almighty arm rules over all,—and that He works by the same fixed laws through all parts of his boundless realm. The certainty with which all the predictions of astronomers, made on these suppositions are fulfilled, attest the soundness of the hypothesis. Accordingly, those laws, which all experience, endlessly multiplied and varied, proves to be the laws of terrestrial motion, are held to be the laws that govern also the motions of the most distant planets and stars, and to prevail throughout the universe of matter. Let us, then, briefly review these great laws of motion, which are three in number. The **FIRST LAW** is as follows:—*Every body perseveres in a state of rest, or of uniform motion in a straight line, unless compelled by some force to change its state.* By *force* is meant anything which produces motion.

The foregoing law has been fully established by experiment, and is conformable to all experience. It embraces several particulars. First, a body when at rest, remains so, unless some force puts it in motion; and hence it is inferred when a body is found in motion, that some force must have been applied to it sufficient to have caused its motion. Thus the fact, that the earth is in motion around the sun and around its own axis, is to be accounted for by assigning to each of these motions a force adequate, both in quantity and direction, to produce these motions respectively.

Secondly, when a body is once in motion, it will continue to move for ever, unless something stops it. When a ball is struck on the surface of the earth, the friction of the earth and the resistance of the air soon stop its motion: when struck on smooth ice, it will go much further before it comes to a state of rest, because the ice opposes much less resistance than the ground; and, were there no impediment to its motion, it would, when once set in motion, continue to move without end. The heavenly bodies are actually in this condition: they continue to move, not because any new forces are applied to them; but, having been once set in motion, they continue in motion because there is nothing to stop them. This property in bodies to persevere in the state they are actually in,—if at rest, to remain at rest, or if in motion, to continue in motion,—is called *inertia*. The inertia of a body (which is measured by the force required to overcome it) is proportioned to the quantity of matter it contains. A steamboat manifests its inertia, on first starting it, by the enormous expenditure of force required to bring it to a given rate of motion; and it again manifests its inertia, when in rapid motion, by the great difficulty of stopping it. The heavenly bodies having been once put in motion, and meeting with nothing to stop them, move on by their own inertia. A top affords a beautiful illustration of inertia, continuing, as it does, to spin after the moving force is withdrawn.

Thirdly, the motion to which a body naturally tends is *uniform*; that is, the body moves just as far the second minute as it did the first, and as far the third as the second,—and passes over equal spaces in equal times. I do not assert that the motion of all moving bodies is *in fact* uniform, but that such is their *tendency*. If it is otherwise than uniform, there is some cause operating to disturb the uniformity to which it is naturally prone.

Fourthly, a body in motion will move in a *straight line*, unless diverted out of that line by some external force: and the body will resume its straightforward motion, whenever the force that turns it aside is withdrawn. Every body that is revolving in an orbit, like the moon around the earth, or the earth around the sun, *tends* to move in a straight line, which is a tangent\* to its orbit. Thus, if A B C, Fig. 28, represents the orbit of the moon around the earth, were it not for the constant action of some force that draws her towards the earth, she would move off in a straight line. If the force that carries her towards the earth were suspended at A, she would immediately desert the circular motion, and proceed in the direction A D. In the same manner, a boy whirls a stone around his head in a sling, and then letting go one of the strings, and releasing the force that binds it to the circle, it flies off in a straight line, which is a tangent to that part of the circle where it was released. This ten-

\* A tangent is a straight line touching a circle, as A D, in Fig. 28.

dency, which a body revolving in an orbit

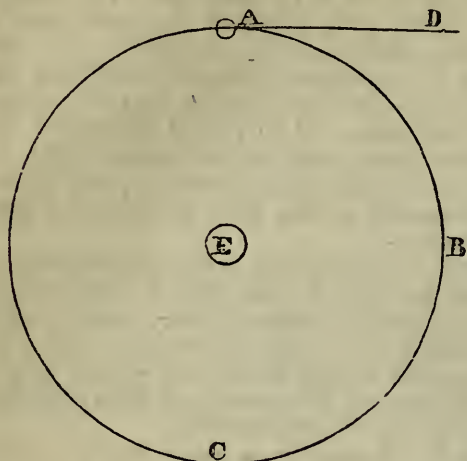


Fig. 28.

and the exterior portions are projected with great violence. In like manner, as the equatorial parts of the earth, in the diurnal revolution, revolve much faster than the parts towards the poles, so the centrifugal force is felt most at the equator, and becomes strikingly manifest by the diminished weight of bodies, since it acts in opposition to the force of gravity.

Although the foregoing law of motion, when first presented to the mind, appears to convey no new truth, but only to enunciate in a formal manner what we knew before, yet a just understanding of this law, in all its bearings, leads us to a clear comprehension of no small share of all the phenomena of motion. The second and third laws may be explained in fewer terms.

The SECOND LAW of motion is as follows:—*Motion is proportioned to the force impressed, and in the direction of that force.*

The meaning of this law is, that every force that is applied to a body produces its full effect, proportioned to its intensity, either in causing or in preventing motion. Let there be ever so many blows applied at once to a ball, each will produce its own effect in its own direction, and the ball will move off, not indeed in the zigzag, complex lines corresponding to the directions of the several forces, but in a single line expressing the united effect of all. If you place a ball at the corner of a table, and give it an impulse, at the same instant, with the thumb and finger of each hand, one impelling it in the direction of one side of the table, and the other in the direction of the other side, the ball will move diagonally across the table. If the blows be exactly proportioned each to the length of the side of the table on which it is directed, the ball will run exactly from corner to corner, and in the same time that it would have passed over each side by the blow given in the direction of that side. This principle is expressed by saying, that a body impelled by two forces, acting respectively in the directions of the two sides of a parallelogram, and proportioned in intensity to the lengths of the sides, will describe the diagonal of the parallelogram in the same time in which it would have described the sides by the forces acting separately.

The converse of this proposition is also true; namely, that any single motion may be considered as the *resultant* of two others,—the motion itself being represented by the diagonal, while the two *components* are represented by the sides, of a parallelogram. This reduction of a motion to the individual motions that produce it, is called the *resolution of motion*, or the *resolution of forces*. Nor can a given motion be resolved into two components, merely. These, again, may be resolved into others, varying indefinitely, in direction and intensity, from all which the given motion may be considered as having resulted. This composition and resolution of motion or forces is

exhibits, to recede from the centre and to fly off in a tangent, is called the *centrifugal force*. We see it manifested when a pail of water is whirled. The water rises on the sides of the vessel, leaving a hollow in the central parts. We see an example of the effects of centrifugal action, when a horse turns swiftly round a corner, and the rider is thrown outwards; also, when a wheel passes rapidly through a small collection of water, and portions of the water are thrown off from the top of the wheel in straight lines which are tangents to the wheel.

The centrifugal force is increased as the velocity is increased. Thus, the parts of a millstone most remote from the centre sometimes acquire a centrifugal force so much greater than the central parts, which move much slower, that the stone is divided,



often of great use, in inquiries into the motions of the heavenly bodies. The composition often enables us to substitute a single force for a great number of others, whose individual operations would be too complicated to be followed. By this means, the investigation is greatly simplified. On the other hand, it is frequently very convenient to resolve a given motion into two or more others, some of which may be thrown out of the account, as not influencing the particular point which we are inquiring about, while others are far more easily understood and managed, than the single force would have been. It is characteristic of great minds, to simplify these inquiries. They gain an insight into complicated and difficult subjects, not so much by any extraordinary faculty of seeing in the dark, as by the power of removing from the object all incidental causes of obscurity, until it shines in its own clear and simple light.

If every force, when applied to a body, produces its full and legitimate effect, how many other forces soever may act upon it, impelling it different ways, then it must follow, that the smallest force ought to move the largest body; and such is in fact the case. A fillip of a finger upon a seventy-four under full sail, if applied in the direction of its motion, would actually increase its speed, although the effect might be too small to be visible. Still it is something, and may be truly expressed by a fraction. Thus, suppose a globe, weighing a million of pounds, were suspended from the ceiling by a string, and we should apply to it the fillip of a finger,—it is granted that the motion would be quite insensible. Let us then divide the body into a million equal parts, each weighing one pound; then the same impulse, applied to each one separately, would produce a sensible effect, moving it, say one inch. It will be found, on trial, that the same impulse given to a mass of two pounds will move it half an inch; and hence it is inferred, that, if applied to a mass weighing a million of pounds, it would move it the millionth part of an inch.

It is one of the curious results of the second law of motion, that an unlimited number of motions may exist together in the same body. Thus, at the same moment, we may be walking around a post in the cabin of a steam-boat, accompanying the boat in its passage around an island, revolving with the earth on its axis, flying through space in our annual circuit around the sun, and possibly wheeling, along with the sun and his whole retinue of planets, around some centre in common with the starry worlds.

The THIRD LAW of motion is this: *Action and reaction are equal, and in contrary directions.*

Whenever I give a blow, the body struck exerts an equal force on the striking body. If I strike the water with an oar, the water communicates an equal impulse to the oar, which, being communicated to the boat, drives it forward in the opposite direction. If a magnet attracts a piece of iron, the iron attracts the magnet just as much, in the opposite direction; and, in short, every portion of matter in the universe attracts and is attracted by every other, equally, in an opposite direction. This brings us to the doctrine of universal gravitation, which is the very key that unlocks all the secrets of the skies. This will form the subject of my next Letter.

*(To be continued.)*

**THE END OF EDUCATION.**—The multitudes think that to educate a child is to crowd into its mind a given amount of knowledge; to teach the mechanism of reading and writing; to load the memory with words; to prepare for the routine of trade. No wonder, then, that they think everybody fit to teach.

The true end of education is to unfold and direct aright our whole nature. Its office is to call forth powers of thought, affection, will, and outward action; power to gain and spread happiness. Reading

is but an instrument; education is to teach its best use.

The intellect was created, not to receive passively a few words, dates, and facts, but to be active for the acquisition of truth. Accordingly, education should inspire a profound love of truth, and teach the process of investigation. A sound logic, by which we mean the science of the art which instructs in the laws of reasoning and evidence, in the true method of inquiry and the source of false judgment, is an essential part of a good education.

## THE MIRROR OF NATURE.

*(Continued from page 76.)*

Poor Duval remained there now with his discovery, ashamed and at a loss; either the charts, for which he had sacrificed his whole property, were good for nothing, or the key to them lay so entirely hidden from him, that he must give up the hope of finding it. But even on this occasion, as it always opportunely happens in the animal and in the spiritual world, his awakened desire found its gratification. Our young hermit was accustomed to attend mass at Luneville every Sunday, and on these occasions to execute various commissions for the brethren. On the next day after the disheartening event, which had befallen him in the career of his investigations, he made his Sunday visit to the city, and at the close of the mass, walked a while in the garden of the monastery. There he saw Mr. Remy, the gardener, seated at the end of a walk, reading. His curiosity, always awake, prompted him to ask what the gentleman was reading; and to his joyful surprise, he learned that the book was an Introduction to the learning of Geography. It was De Launai's little geography, very popular at the time. Poor Duval burned with desire to read the book; he ventured the entreaty, that Mr. Remy would lend it to him, and his request was complied with. With the intention of transcribing it, he took the book with many thanks, but could not resist the desire immediately to know its contents. Already on his way home, he learned that the little black and white spaces on the central line of his representation of the globe, denoted *degrees*, every one of which was twenty-five French miles, fifteen German geographical miles, and in every country, according to the difference in the length of its miles, a certain number of that common measure of distance. He immediately learned also, what the other lines meant, which cut the central line or the equator, from the north to the south. He thought now of nothing but making himself a globe, in order to the better understanding of what he had learned. Hazel-sticks bent to represent one way the length, and the other the breadth of the earth, were fastened to-

gether horizontally and perpendicularly, and then notched with a knife to represent three hundred and sixty degrees in one direction, and ninety in the other. Now first was the distinct understanding of his charts laid open to our inquiring young hermit, when he spread them out upon the ground under the shelter of the wood, and by aid of the compass which he had borrowed, arranged them in the due directions. Then his inquiring spirit could wander forth from the point where Luneville lay now to this country, now to that, in this, or the other quarter of the globe, and shortly he could answer promptly and with certainty any question about the situation of this or that place.

Not content with this, he sought out in De Launai's Geography, the course of the rivers and the outlines of the sea coast, noted on both the situations of remarkable cities, especially of the capitals. His success was such that, after a while, he was as familiar with the several cities on his charts, as their own citizens, and as he was with the different parts and trees of the woods near St. Anna. Other thoughts also came into his mind, which attracted him on to still further investigations. The broad expanse of water on the globe, in comparison with the much smaller portion of inhabited land, filled him with astonishment. What kinds of living creatures, so he asked himself, are moving in the depths of the sea, and for what are they created, since man, the lord of the earth, cannot see nor know, much less make use of them?

The longing for knowledge in Duval had risen to a passionate height. It was now directed especially towards other countries, of which he thought all day and dreamed by night; the circle of his knowledge had extended in other directions. In every house, whither the errands of his old masters led him, he inquired for books; and where books were to be got, if he could not find one, he took another. In this way a translation of "Plutarch's Lives" and the history of "Quintus Curtius" had come into his hands, and became his amusement in the retired grotto of the old quarry. But all these new elements of knowledge were the sparks which kindled the desire to know more. The whole earth with its countries, not only as they are



now, but as they formerly were, when other races inhabited them, he longed to know. Before every old wall, before every monument of past times, he paused with reverential thoughts; he contemplated every stone, every inscription, and would gladly have understood their language, to learn who had dwelt there, and what were their fortunes.

Books, in his innocent over-estimate of human wisdom, seemed to teach and tell all things. But how was he to procure books, after he had spent all his wealth in the purchase of his charts? The book-sellers, old and new, whose shops he often visited, devouring, with greedy eyes, the titles of the books, when nothing more was permitted, would not so much as lend their treasures. What one wished to obtain from them, could be had only for money; but money,—where was this to be gotten?

A spiritual force, like that which stirred in Duval, breaks for itself a path through all external obstructions, and powers are developed unknown to one who has grown up surrounded by abundance. Duval had learned that the skins of certain wild animals, as well as the flesh of others, were sold in the city, at greater or less prices. In that portion of the forest belonging to them, the proprietors of St. Anna had the right, not only to pasture their cows, but also to hunt and catch the game, birds, and quadrupeds. The former owners of the place had exercised the latter right to its full extent; but since that resort of the huntsman had become, by brother Michael's purchase, occupied by quite other inmates, and the forest, with its wild animals, was the property of pious, peace-loving hermits, it had fallen under the power of those four-footed tyrants of the wood, which the huntsman justly pursued as hurtful. Martens and pole-cats, foxes and wild cats, here perpetrated their murderous deeds undisturbed, for the good old brothers had neither guns nor other fire-arms, they made use of neither snares nor poison, in order to execute justice, as would have been their duty, upon the robbers and murderers in their domain. When Duval saw the nightingale, whose song delighted him, bleeding in the talons of the wild cat, or the young of the thrush or the robin carried off and destroyed by a nightly

attack of the blood-thirsty marten, he was not disposed to allow such things to be. The lament, which the parent birds raised the next morning over their empty nest, touched him deeply. The birds uttering their melancholy longing for that which they had loved and possessed, stirred in him a melancholy longing for that which he too loved but did not possess. Both might be assisted. The cries of the innocent sufferers called for retribution, and the murderers must atone for their guilt with life and wealth; and upon whom could the office of avenging the birds better devolve than on him who exercised the authority of judge and avenger with a powerful hand? No other transferable property was found on the guilty than their fur, and this Duval appropriated to himself.

The old fathers of St. Anna, although they lived on terms of neutrality\* and peace with the wild inhabitants of the neighbouring wood, sometimes experienced an emotion of irritation against their bold four-footed neighbours, when they discovered sometimes of a morning that their geese had been robbed by the fox, and the poultry murdered by the marten and the pole-cat. They made no objection then, when their young attendant joined to his office of herdsman the business of a hunter, and came home, now with the trophy of a fox-skin, and now with the felt of a marten. How the strange lad, without gun, lead, or powder, armed only with bow and arrows, succeeded with various ingenious traps in catching the cunning fox and the shy marten, the brethren heard often with admiration. But his hunting was not always without its dangers. One day he entered the common room, bleeding with many wounds and covered with blood, with a dead wild cat borne on a stick as a trophy. He had boldly chased this murderous animal until, wounded on the head by his club, it took refuge in a hollow tree. There, in its hiding hole, he worried it so with his stick, that the animal at last rushed fearlessly out and sprang upon his head, which it tore with its talons and its teeth, until the stout youth tore it off and dashed its head against the trunk of the tree. He called quietly to the terrified fathers: "Don't be frightened, reverend

fathers, no harm has happened to me. You see here the murderer of our singing birds. I have conquered him, and washing with a little water and wine will soon heal my wounds."

To the officer of justice, who inflicts the punishment of death on criminals, rightfully belongs, not only their moveable possessions, but also all their remaining property and income, as their natural heirs are like them outlawed, and have fled the country. The revenues of the foxes and martens consisted particularly in the flesh of hares and woodcocks, and in the autumn, now and then, of snipes. Of these Duval appropriated, in his trade with the furriers, hatters, and cooks, as many as fell into his traps. And in the mistaken idea that all the game found in the wood-district of the former hunting-house of Alba and present hermitage of St. Anna, belonged to the latter, he would have entrapped even the deer and the roes, that were reserved for the Duke, if they had been more abundant, and could have been dug out and smoked out and caught as easily as the fox and the marten, or as that shameless foe of the harmless, playful fishes, the sea-otter.

The sale of the hares and woodcocks to the furriers, hatters and cooks was lucrative beyond our young hunter's utmost expectations. In a few months he had made from thirty to forty dollars. With this large sum, as it seemed to him, he ran, with the permission of the hermits to Nancy, the city of learning and the arts, some six leagues off. For he had heard that there, more valuable books, and in greater abundance, were to be bought than in Luneville, where the patronage of the court was more eagerly sought than that of the Muses. For him, every book that could teach him anything, had a priceless value; but what its value might be, commercially regarded, he knew not. A novice in trade, he used therefore, to lay his money on the counters of the book-sellers, begging them to take no more from his poverty than the books selected by him, according to a reasonable, Christian estimate, were worth. There was, alas! but one among these tradespeople, who honestly resisted the temptation of the money thus offered, and who took no advantage of the unbounded confidence of

the inexperienced youth. This gentleman was Mr. Truain, who, born in Brittany, had established himself in Nancy. He treated the true-hearted lad as a generous friend, let him have all the books he desired at the lowest possible price, and when his money gave out, trusted his honest countenance for several books which he wished. Mr. Truain guessed not at this time that the rustic youth, who stood there before him, would in a few years have in charge the royal library of Lorraine, and would then be in a situation richly to reward his kindness by selecting him as chief purveyor for the same.

Among the literary treasures, which, at this time Duval procured were translations of Pliny, Theophrastus and Livy, with notes by Vigenere, and also the history of the Incas, Las Casas' description of the cruelties practised by the Spaniards in America, Lafontaine's "Fables," Louvois' "Testament," Rabutin's "Letters," and several maps. The books above named, with some others, formed a dear burthen for our hermit in more senses than one. He had joyfully given all the money he had obtained by hunting for these books, and taken yet others from Mr. Truain on credit. With joy he took the burthen on his stout shoulders and bore it, resting from time to time, on the same day to his hermitage, distant a good journey from Nancy.

The cell which had been given to Duval for his sleeping and sitting-room, was almost too small to hold both its inmate and his property at the same time. It now became a world in little, for the ceiling was ornamented with the representation of the heavens, the celestial chart, and the walls were adorned with the maps of the different quarters of the globe.

Among the four old residents of the hermitage, there was one who differed in many respects from the other three, and especially from the gentle brother Paul. This individual, Anthony by name, was a native of Bar, whose inhabitants are generally reputed to be easily irritated and quarrelsome. Although he was the oldest in years and the most zealous in the exercises of devotion, he had not wholly conquered his naturally irritable disposition. He was severe and strict in the treatment and care of his own body, and



at the same time severe and strict in his judgment of others, so that when he spoke brother Paul liked best to be silent. This somewhat stormy brother, as the oldest of the little company, exercised a sort of authority over the rest. He perceived with great vexation that Duval was less zealous in the social religious exercises, since he had become so much taken up with books and maps, and that he was employed about things which appeared to be neither necessary nor wholesome for a pious person. He reproached himself for having lent the young man his compass, and thereby perhaps contributed to his errors, yet he hoped that his admonitions would on that account have more influence with him. As he saw, however, that Duval gave himself up from day to day ever more devotedly to his thirst for knowledge, he was resolved to get at the bottom of his employments, and so took the opportunity when the young Jack-at-all-trades was absent, to penetrate into his closed cell. How amazed was good brother Anthony, when he descried things such as he had never before seen in the cell of a devotee, and which, therefore, might well seem to him altogether suspicious. What was meant by the celestial globe made of pasteboard, with its white and black circles, which Duval had with great pains made to represent the Ptolemaic system?—What signified the terrestrial globe prepared of bent hazel-twigs?—What were the strange (geometrical) figures and numbers, which the curious Duval had copied and transcribed from a borrowed mathematical book? But more than all these things, brother Anthony was horror-struck at a single word which he read upon a large chart of Tycho Brahe's, filled with astronomical figures and calculations. The inscription ran thus: *Calendarium naturale magicum*. . . "Magicum!" murmured our old hermit full of fright. "Here in a place consecrated to God, will he study magic, that is, sorcery and witchcraft? It must not any longer be allowed."

In the first ebullition of his horror, the old man betook himself to Luneville, to the confessor, a man of distinguished character and learning. To him he gave so strange a description of the pursuits of Duval, and of what he himself had seen in

his cell, that the confessor became curious to look into the affair with his own eyes. Duval, who, in the mean time, had come home, allowed the intelligent father confessor to see and examine everything in his cell, answered freely every question put to him, and the end of the examination was, that the good father showed brother Anthony, with a smile, his ignorance, and the groundlessness of his suspicions, while he commended Duval, encouraged him to persevere, as such learning might some time be of use.

For a time peace appeared to be restored, but brother Antony could not get over being laughed at on Duval's account by the father confessor. In every look of the free-hearted youth, he fancied he saw a reflection of that reproach, and so he cherished a real dislike of Duval. In this unhappy state of mind, the threat once escaped him that he would tear up the maps and take away Duval's books, a threat which the blind zealot looked as if he meant to put to execution. To allow these treasures, the possession of which had cost so much care and trouble, to be destroyed—what warm young blood could have endured the thought without violent excitement? For the first, and so far as known, for the last time, Duval fell into such a violent rage that he lost all control of himself. As a weapon of defence against such a barbarian assault upon his beloved books, he seized the fire-shovel, and presented himself with such a wild, determined aspect before brother Anthony, this imitator of the destroyer of the Alexandrian library, that the old man cried aloud for help. The three brothers, who were at work near by in the field, came to his assistance. The young man, still in fear for his books, drove them with the mere threat of his fire-shovel out of their own dwelling, locked the door, and then watched the movements of the enemy through the window.

It was a fortunate coincidence, that just at this moment the Prior of the Eremites arrived on a visit at St. Anna. He saw and heard the tumult, heard the complaints against the young rebel, against the authority of age; but Duval told his story at the same time from the window. The Prior listened with a quietness which

restored to the youth his composure, and received the grave reproof which the Prior administered to him as silently as brother Anthony received his. Nevertheless, Duval, like a commandant about to surrender his fortress to besiegers, declared that, before the door was opened, he must require security on the following points: 1. An entire amnesty for the past. 2. An allowance of two hours a day for his scientific labours, an indulgence which he would relinquish at seed-time and harvest. On the other hand, he promised on his part to serve the community of hermits for ten years, simply for board and clothing, with all his powers, and with conscientious fidelity. This treaty was accepted, the doors were opened, and on the following day, the agreement reduced to writing was signed by one party with his written name, by the others with a cross.

Peace was now completely restored among the inhabitants of St. Anna, and with peace flourished again for Duval the usual fruits of peace, the arts and sciences. His inquisitiveness led him indeed not unfrequently in wrong paths, which conducted him to no goal of true knowledge, for with uncommon perseverance he read through works, such as Raymond Lully, several times, word for word, and tormented himself for weeks long to find a rational meaning where no meaning was. The books purchased at Nancy and elsewhere, he had not only read, but as far as it was possible, thoroughly digested. He began to think how he should procure additional nutriment of the same sort. The game of the forest were partly annihilated, and had partly strayed away. While he was seeking some other method of supplying his necessities, a way of obtaining what he wanted opened itself before him unsought. One day in autumn as he was walking in the wood, pushing before him the fallen leaves with his foot, he saw something shining. It proved to be a finely wrought gold seal, with an uncommonly beautiful coat of arms. Duval, who knew that such armorial bearings often related to family incidents, and who had made himself familiar with the principles of Heraldry, through Menestrier's Introduction, examined the different parts of the escutcheon, without being able to interpret

them. On the next Sunday he caused the seal to be advertised from the pulpit at Luneville, and after a few days, an Englishman, equally rich in outward and in inward goods, presented himself as the lawful owner of the seal. Mr. Forster, so the gentleman was called, had resided some years in Luneville, devoting himself to scientific inquiries and honourable pursuits. Duval was ready to give up the seal, but he first required as a condition, that the meaning of the coat of arms should be explained to him. How this young man, in a poor peasant's frock, should take any interest in such matters, Mr. Forster did not understand. He accounted the request an expression of ignorant curiosity. He complied, however, with the condition of the honest finder, and was not a little astonished, when he perceived, from the questions and observations of the young hermit, that he was thoroughly acquainted with history and its auxiliary sciences, and even with heraldry, and far better skilled in these things than most boys of his age who were taught in the schools. The curiosity of this youth was indeed touching. It proceeded from such a pure, inward longing for knowledge and truth, it received so gratefully what was offered to it, that the kind Englishman, instantly at the very first interview, took a hearty liking to Duval. He rewarded him with a generous sum of money, and invited his young friend to visit him every Sunday and Friday, at Luneville. In these visits, Duval, with his quick apprehension, learned more in an hour than many students in weeks' and months' attendance in the schools, for Mr. Forster had seen the world, he was not only a lover and promoter of science, but was himself versed in history and antiquities. Besides, the benevolent Englishman was not satisfied with bestowing the spiritual gifts, with which he enriched his eager pupil, but at almost every visit presented him with money.

*(To be continued.)*

Look on the good in others, and the evil in thyself; make that the parallel, and then thou wilt walk humbly. Most men do just the contrary, and that foolish and unjust comparison puffs them up.—*Leighton.*



## THE DISCOVERY OF THE LEYDEN JAR, OR PHIAL.

THE manner in which this discovery (*viz.*, the Leyden Phial) was made at Leyden in Holland, was as follows:—Professor Muschenbroeck and his friends, observing that electrified bodies, exposed to the common atmosphere, which is always replete with conducting particles of various kinds, soon lost their electricity, and were capable of retaining but a small quantity of it, imagined that were the electrified bodies terminated on all sides by original electrics, they might be capable of receiving a stronger power, and retaining it a longer time. Glass being the most convenient electric for this purpose, and water the most convenient non-electric, they first made these experiments with water, in glass bottles; but no considerable discovery was made, until Mr. Cunens happening to hold his glass vessel in one hand, containing water, which had a communication with the prime conductor, by means of a wire; whilst with the other hand he was disengaging it from the conductor (when he imagined the water had received as much electricity as the machine could give it), was surprised by a sudden shock in the arms and breast, which he had not in the least expected from the experiment.

Thus was accidentally discovered the electric jar, which in its present improved form is now coated inside and outside with tin foil, to retain the electricity which may be reverberated to the surface of the glass, and which by the communication of the positive side with the negative, gives the shock, well known by the name of the electric shock. It is extremely curious to observe the description which philosophers, who first felt the electric shock, gave of it, especially as we are sure we can give ourselves the same sensation, and thereby compare their description with the reality. Terror and surprise certainly contributed not a little to the exaggerated accounts they gave of it; and could we not have repeated the experiment we should have formed a very different idea of it from what it really is, even when given in greater strength than those who first felt the electric shock were able to give it. It will amuse our readers to give

them an example or two. Mr. Muschenbroeck, who tried the experiment, says, in a letter to Mr. Reaumur, that he felt himself struck in his arms, shoulders, and breast; so that he lost his breath, and was two days before he recovered from the blow and the terror. He adds, he would not take a second shock, no, not for the kingdom of France. A Mr. Allamand said, that he lost the use of his breath for some moments, and then felt so intense a pain all along his right arm, that he at first apprehended ill consequences from it, though it soon after went off without any inconvenience. But the most remarkable account is that of Mr. Ninkler, of Leipsic. He says, that the first time he tried the Leyden experiment, he found great convulsions by it in his body, and that it put his blood into great agitation, so that he was afraid of an ardent fever, and was obliged to use cooling medicines: he also felt a heaviness in his head, as if a stone lay upon it. Twice, he says, it gave him a bleeding at the nose, to which he was not inclined; and that his wife (whose curiosity, it seems, was stronger than her fears) received the shock only twice, and found herself so weak that she could hardly walk; and that a week after, upon recovering courage to receive another shock, she bled at the nose, after taking it only once. Such was the surprise and terror with which these electricians were struck, by a sensation which thousands have since experienced without any disagreeable effects; and it affords us a lesson how far we ought to credit the first accounts of extraordinary discoveries, where the imagination is liable to be affected. On account of this experiment being first satisfactorily made at Leyden, a bottle, coated inside and out, for the purpose of charging and discharging, is called a Leyden Phial, or Electric Jar.

If you take a great deal of pains to serve the world and to benefit your fellow-creatures, and if, after all, the world scarcely thanks you for the trouble you have taken, do not be angry and make a long talking about the world's ingratitude; for if you do, it will seem that you cared more about the thanks you were to receive than about the blessings which you professed to bestow.

## ADVICE TO YOUNG STUDENTS.

NEAR seventy years of my pilgrimage are gone, and like my forefathers I am but a sojourner in this land of sorrows. The remnant of my days I devote to the rising generation. The inexperience and rashness of youth, call loudly for the guidance of age. Perilous is the voyage of life. Many precious cargoes are lost in the tempestuous passage—several individuals have I beheld, even in my time, embarking within the flattering prospect of gaining the desired haven. But, alas! the surly winds arose—the unmerciful tempest howled—the face of heaven grew black and lowering, and the devouring waves swallowed their little vessel—it sunk, and, ah! it rose no more! In most cases the want of an intelligent and experienced pilot, occasions the dreadful catastrophe. The trickling tear, and the heaving sigh, recall not past circumstances. Let hope, the elevator of the human heart and the ornament of the human life, impel to vigorous exertions. For have you not, ere I write this, been conducted to that “hill side” well described to be “steep at first ascent,” also so smooth, so green, so full of goodly prospects and melodious sounds on every side that the harp of Orpheus was not more charming? Should the obviousness of these lines require an apology, you have it in this ancient adage, “What is not sufficiently attended to cannot be too frequently repeated.”

I. Avoid night studies—they are the bane of health, and gradually ruin the most robust constitution. Soon enter your bed at night, and leave it soon in the morning. The faculty extol early rising as a powerful specific against disease. In the morning the air is most salubrious; the mind best fitted for instruction; and the spirits cheered, beholding the sun starting from the east and gilding every opening prospect. Temperance and exercise are the best physicians. The ancients observed, the immediate agency of heaven inflicted acute diseases, but those of the chronic kind were of our formation; nor are the moderns less explicit on the subject. Addison, when he beheld a fashionable table in all its magnificence, fancied he saw gouts and dropsies, fevers

and lethargies, with other innumerable distempers lying in ambuscade among the dishes. And Sir William Temple used to say, the first glass for myself, the second for my friends, the third for good-humour, and the fourth for mine enemies. Your meat and drink, your company, and your amusements should be answerable to the calls of nature, and subservient to the welfare of the animal economy.

II. Time must be properly occupied. To some particular employ appropriate every hour. Never appear as if you knew not how to dispose of yourself. Of the utmost importance is a judicious distribution of the day. Anarchy accompanies the want of arrangement. The Fine Arts, Natural History, and many other useful studies may employ spare hours. Waste not even the particles of time, for like particles of gold, they possess their separate value. The learned Erasmus when on horseback travelling into Italy, wrote the celebrated treatise entitled “The Praise of Folly.”

III. Having obtained a knowledge of the sciences, and carefully consulted your genius, apply to that branch of literature for which you experience the greatest predilection. Some are fond of the languages and Belles Lettres: others of mathematical and astronomical speculations: some of natural and others of moral philosophy. Examine the bent of your mind. It is of moment to ascertain the intellectual current. Prosecute with ardour what you pursue, and be your speculations subservient to the practical purposes of life. They who boast of an universal genius are sometimes superficial, never arrive at much eminence, and do little good to the community at large.

IV. In your studies there should be an intermixture. Works of reasoning and of imagination, of judgment and of fancy associate together. Like the seasons of the year, they afford agreeable variety. Severe and continued application tries the most gigantic intellect. The faculties of the mind however should not be suffered to remain dormant, for they gain vigour and maturity by exercise. Prejudices of every kind throw aside, they grievously warp the understanding, and sorely bias the judgment. Proteus-like, error as-



sumes multifarious forms; and it is the scholar's province to strip away its disguise. Bacon terms inquiry after truth, the wooing of it: knowledge of truth the presence of it: and the influential belief of truth the enjoyment of it. Credulity is a yawning gulf which swallows every thing thrown into it.

V. Let a judicious friend recommend the books you read. The sages of antiquity deemed a great book—a great evil. The numerous volumes that meet us in the walks of theology, history, poetry, criticism, and moral philosophy, afford ample scope to the guidance of an able and enlightened friend. Regard the quality rather than the quantity of what you peruse; it has been ingeniously observed, were quantity alone the estimate of improvement, subscribers to a circulating library should be as wise as Socrates, and as accomplished as Julius Cæsar.

VI. Persevere in a regular plan of study once carefully laid down. Break not in upon its sacred confines, pursue it with becoming energy, and your stores of knowledge will insensibly increase: Perseverance is the parent of wonders. Such is its influence, that it has been said, he who walks with vigour three hours a day, in seven years travels a space equal to the circumference of the globe. Without labour, nothing excellent is given to the children of Adam. An inordinate love of novelty, and a desultoriness of genius, are inimical to sound improvement. The poets, orators, and historians of former ages were enamoured of a close study, and inured to profound investigations. Homer and Thucydides, Plato and Aristotle, Livy and Cicero, Virgil and Horace, together with Bacon, Milton, Locke, and Newton, the four pillars which are said to support the monument of British genius, were all severely studious, and adhered with incredible steadiness to the pursuit of knowledge. When the Romans took Syracuse, Archimedes was so deeply engaged solving a problem, that he was ignorant of the enemy being in possession of the town; and a soldier, not knowing who he was, killed him, because he refused to follow him. An emperor once asked an ancient philosopher to instil into his mind the principles of astronomy,

without his undergoing the fatigue of study! The philosopher honestly replied, there was no imperial way to astronomy.

VII. Cultivate a cheerfulness of disposition. Discontent and ill-nature are enemies to the muses. Be willing to please, and easy to be pleased. Avoid dwelling long on the dark side of human life. To peruse writers who delight in exhibiting such a representation, enfeebles the spirits, sours the temper, and beclouds the soul. To the vices of mankind oppose their virtues: and with the calamities to which we are exposed, contrast the many blessings we enjoy. A writer who portrays only the dark side of human life has, with great propriety, been compared to a painter who collects in his piece, objects of a black hue only; who presents you with a black man, a black horse, a black dog, &c., &c., and tells you that this is a picture of nature, and that nature is black. It is true, you would reply, the objects you exhibit do exist in nature, but they form a very small part of her works. You say that nature is black, and to prove it, you have collected on your canvass all the animals of this hue that exist; but you have forgot to paint the green earth, the blue sky, the white man, &c. Perpetual study evaporates the animal spirits, and oppresses the nerves. Excessive application gives birth to strange consequences. One learned man supposed the Divine Being had deprived him of his rational soul, when at the same time he wrote a masterly treatise against infidelity, and expressed this whim in his dedication to the Queen of Great Britain. Another learned gentleman imagined the earth was a living animal, the flux and reflux of the sea, the effects of his respiration; men, and other creatures, insects, which fed upon it—bushes and trees, the bristles on his back, and the water or seas and rivers, a liquid which circulated in his veins. To prevent these effects, and others equally romantic, form to yourself a conversive circle of friends, who, mingling together instruction and amusement, happily relieve the toil of the closet: nor by any means shun the company of good-tempered and virtuous females: over the student's mind their manners shed a felicitating influence; the elegant endearments of female friendship soften the heart, me-

literate the disposition, annihilate eccentricities, and produce on the whole of life the most amiable effects. Nor can it excite wonder, for it is congenial to the heart of man to be affected by female excellence.

VIII. And lastly. Accompany exertions for the attainment of knowledge, and endeavour to arrive at eminence, with prayers to the *Father of Spirits* for his concurrence and blessing. To the appearance of youth, the garb of humility adds comeliness; and on the youthful countenance the blush of modesty is doubly graceful. Dogmatism in youth is intolerable; and illiberality indicates a weak head or a bad heart. Above all, avoid scepticism and levity, and manifest to all who know you, that you are susceptible of devout emotions towards the Author of your being. Let the Christian religion, which originates in love, with its evidences, as taught in the Scriptures, settle your mind. Then will your faith remain unshaken by the abuse of Bolingbroke, the sneer of Voltaire, the subtlety of Hume, or by any of the oblique or invidious arts employed by the adversaries of revelation to undermine its truth, or lessen its importance. Perplex not your mind with the distortions of metaphysical creeds, the absurdities of corrupted formularies, the encumbrances of superstition, and the unmeaning sallies of enthusiasm. I shall conclude with the dying words of a nobleman to his sons: "Religion will instruct you how to act usefully and happily in this present scene—to leave it with composure, and be associated in a future and better state, to the best moralists and philosophers that ever lived—to the wisest men, and greatest benefactors of mankind—to confessors and martyrs for truth and righteousness—to Prophets and Apostles—to Cherubim and Seraphim—to Jesus, the Mediator of the new covenant: and to God, the Judge of all, who is before all, above all, and in us all." T. N.

THE only uniform and perpetual cause of public happiness is public virtue. The effects of all other things which are considered as advantages will be found casual and transitory. Without virtue nothing can be securely possessed or properly enjoyed.

## ANIMAL CHEMISTRY.

How seldom do we give a thought to the organization of the "house we live in," or the manner in which it is strengthened or undermined! We seem to think that it can take care of itself exactly as well without our aid as with it, and better, too, perhaps. We don't reflect that, after all, we are mere animal chemical machines, and that various substances combined in the human stomach present the same phenomena that they would in the receivers of a chemist's laboratory. For example, we see it stated that without lime the secretion of milk fails; "the bones and teeth become soft or are arrested in their development; without soda, no bile can be formed; without phosphorus and magnesia, the nervous tissues lose their energy and the impaired condition of the brain is evinced by loss of memory, frightful headaches and impending paralysis.

"Ghastly paleness, prostration, faintings, and coldness, attend the lack of carbon; deprived of sulphur, the hair would rapidly cease to grow, and the absence of iron is marked by lividity, disordered digestion, passive dropsy and other symptoms of an anæmic or chlorotic character. The food we receive daily furnishes the natural source of these elementary substances, and serves during health to repair the waste of these matters through the system, being, as they are, consequent upon the voluntary and vegetative functions of the economy. Hence the equilibrium is preserved. Inordinate use of particular organs induces a disproportionate consumption of their substance, and hence of the elements from which this substance is formed. Excesses in watching, thought, and muscular effort, for examples, by overtaxing the brain and muscular fibre, render these tissues rapidly effete, and therefore cause an exaggerated demand for their particular pabulum, as phosphorus and iron."

A MOTHER.—Let no young man expect success or prosperity who disregards the advice and instruction of his mother. What can be more consoling in severe affliction than the fond recollection of a pious mother's prayers and tears poured forth and shed in infancy for her beloved offspring?



## FAMILIAR CONVERSATIONS ON INTERESTING SUBJECTS.

"CAN you tell me anything more about flowers this morning, mother?" asked Clara, a few days after the last conversation on flowers between her and her mother took place. (See p. 22, vol. iv.)

"Yes, my dear," replied Mrs. Wilson. "I was just thinking about sending for you, for that purpose. I suppose you have not forgotten what I told you about the different parts of the flower?"

No, mother; I was going over them to myself a little while ago, and I could distinguish them all quite perfectly."

"I told you the other day that plants were divided into classes, orders, &c. Classes are the largest division. According to the system which is now most commonly adopted, there are twenty-one classes.

"How are these distinguished from each other, mother?"

"By the number of stamens they contain; that is the first ten are distinguished in that way; the remaining eleven, upon distinctions observed in the stamens."

"Then I suppose, mother, a plant with one stamen belongs to the first class; one with two to the second, and so on?"

"Yes."

"Then the lily, having six stamens, is of the sixth class; and the pink having ten is of the tenth class."

"Just so. This division of plants into classes, orders, &c., may be compared to the general divisions of the inhabitants of the earth; thus classes are like to the different nations of men; orders, to the different divisions of nations; genera, the different families which compose these several divisions; and species, the different individuals which compose a family."

"Then, I suppose, the name of the genera is like to the surname of a person, and the name of the species to the individual or Christian name?"

"Yes, but when you speak of a single family of plants, you should say genus, not genera; genera is the plural of genus. But the specific name of the flower, instead of preceding the family name as it does among the families of men, follows after."

"What! just as if you were to call me Wilson Clara, instead of Clara Wilson?"

"Yes; there are many different kinds or species of roses you know: in Botany they are termed *Rosa canina*, or dog-rose, *Rosa Damascena*, or Damask rose, *Rosa alba*, or white rose, &c."

"Why how foolish this seems, mother!"

"It is owing to these names being of Latin origin; and in that language the adjective generally follows the noun."

Are the names of the classes and orders of Latin origin too, mother?"

"No; the first twelve classes are named by prefixing Greek numerals to the word *Andria*, which signifies stamen. Here is a list of Latin and Greek numerals which I have written for you, which you had better commit to memory, as it will enable you to understand better the names of the classes and orders.

LATIN.		GREEK.	
Unus .....	1	Monos.	
Bis .....	2	Dis.	
Tres .....	3	Treis.	
Quatuor .....	4	Tessares.	
Quinque .....	5	Pente.	
Sex .....	6	Hex.	
Septem .....	7	Hepta.	
Octo .....	8	Okto.	
Novem .....	9	Ennea.	
Decem .....	10	Deka.	
Undecim .....	11	Endeka.	
Duodecim .....	12	Dodeka.	
Tredecim .....	13	Dekatreis.	
Quatuordecim .....	14	Dekatessares.	
Quindecim .....	15	Dekapente.	
Sexdecim .....	16	Dekahex.	
Septemdecim .....	17	Dekæpta.	
Octodecim .....	18	Dekaokto.	
Novemdecim .....	19	Dekænnea.	
Viginti .....	20	Eikosi.	
Multus .....	Many	Polus.	

"Then, mother, I suppose," said Clara, after looking over the list for a few minutes "the first class is called *Monos-andria*, the second, *Dis-andria*, &c.?"

"No; only a portion of the numeral is prefixed, thus:—

Mon-andria .. 1 stamen	Hex-andria.. 6 stamens
Di-andria ... 2 "	Hept-andria. 7 "
Tri andria ... 3 "	Oct-andria... 8 "
Tetr-andria... 4 "	Enne-andria 9 "
Pent andria... 5 "	Dec-andria 10 "

"That is only ten classes, mother, I thought you said twelve were named in this way?"

"These classes, you know, depend upon the number of stamens they contain; the other two have a different distinction."

"What is that distinction, mother?"

"The eleventh class, *Icos-andria*, from

Eikosi 20, has more than ten stamens, which are inserted on the calyx. The twelfth class, Poly-andria, from Polus, many, has also more than ten, but they are inserted on the receptacle."

"Then, mother, I should say the Poppy belonged to the twelfth class?"

"Yes; and can you not think of some belonging to the eleventh? look into your bouquet, I think you will find one there."

"The rose, doesn't it, mother?"

"Yes."

"Now, how are the other classes known?"

"The thirteenth has four stamens; two of which are longer than the other two. The fourteenth has six; four of which are longer than the others."

"How are these named, mother?"

"By prefixing Greek numerals to Dynamia, which signifies power or length: thus Di-dynamia 13, Tetra-dynamia, 14."

"What flowers belong to these classes?"

"Of the former, we might name the wall-flower, and the fox-glove; of the latter, cabbage, mustard, radish and other important table vegetables. The next two classes, are named by prefixing Greek numerals to adelphia, which signifies brotherhood: thus, Mon-adelphia, 15; Dia-adelphia, 16."

"How are they known, mother?"

"The former have their stamens united by their filaments into one set, as we see in the passion-flower and geraniums; the latter have their filaments united into two sets. Peas, beans, and many of the most delicious table vegetables, are found in this class. The next class is named by prefixing Syn, which signifies together, to Genesia, which signifies growing up."

"Syn-genesia—growing up together, then is the 17th class; but how are we to know it, mother?"

"This class comprises a great many plants; generally those that blossom late in the summer, and in the autumn. Its distinguishing mark is, that the stamens are united by the anthers, instead of by the filaments, as in the classes Monadelphia, and Dia-adelphia. To this class belong the sunflower, marigold, and chrysanthemum."

"How is the next class distinguished, mother?"

"By the stamens and pistils being

united, as we see in the lady's slipper. It is named by prefixing an abbreviation of the word Gynia, which signifies pistil, to andria, thus Gyn-andria."

"I don't think the plants of this class are very numerous, mother, are they?"

"They are not so easily found as some of the other classes are, because they seem to prefer their own native wilds to the refinements of civilized life. Next we have Mon-œcia, 19, and Di-œcia, 20."

"What is the meaning of 'œcia,' mother?"

"It signifies a house. The former class has flowers upon the same root, or house, some of which possess only stamens, and some only pistils; the latter has similar flowers, that is, flowers with stamens, and flowers with pistils, on separate plants. But I am afraid I have now told you more than you can recollect, so I will leave off this subject for the present. I would advise you also to go at once, and write down the names and distinctions of these different classes, which will enable you the better to remember them."

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HOW TO ADMONISH.—We must consult the gentlest manner and softest reasons of address; our advice must not fall like a violent storm, bearing down and making those to droop whom it is meant to cherish and refresh. It must descend as dew upon the tender herb, or like melting flakes of snow; the softer it falls the longer it dwells upon, and the deeper it sinks into, the mind. If there are few who have humility to receive as they ought, it is often because there are as few who have the discretion to convey it in a proper vehicle, and to qualify the harshness and bitterness of reproof, against which corrupt nature is apt to revolt, by an artful mixture of sweet and pleasant ingredients. To probe the wound to the bottom, with all the boldness and resolution of a good spiritual surgeon, and yet with all the delicacy and tenderness of a friend, requires a very dexterous and masterly hand. An affable deportment, and a complacency of behaviour, will disarm the most obstinate. Whereas if, instead of pointing out their mistake, we break out into unseemly sallies of passion, we cease to have any influence.



## SOUNDS DURING THE NIGHT.

THE great audibility of sounds during the night is a phenomenon of considerable interest, and one which had been observed even by the ancients. In crowded cities or in their vicinity, the effect was generally ascribed to the rest of animated beings, while in localities where such an explanation was inapplicable, it was supposed to arise from a favourable direction of the prevailing wind. Baron Humboldt was particularly struck with this phenomenon when he first heard the rushing of the great cataracts of the Orinoco in the plain which surrounds the mission of the Apures. These sounds he regarded as three times louder during the night than during the day. Some authors ascribed this fact to the cessation of the humming of insects, the singing of birds, and the action of the wind on the leaves of the trees, but M. Humboldt justly maintains that this cannot be the cause of it on the Orinoco, where the buzz of insects is much louder in the night than in the day, and where the breeze never rises till after sunset. Hence he was led to ascribe the phenomenon to the perfect transparency and uniform density of the air, which can exist only at night after the heat of the ground has been uniformly diffused through the atmosphere. When the rays of the sun have been beating on the ground during the day, currents of hot air of different temperatures, and consequently of different densities, are constantly ascending from the ground and mixing with the cold air above. The air thus ceases to be a homogeneous medium, and every person must have observed the effects of it upon objects seen through it which are very indistinctly visible, and have a tremulous motion, as if they were "dancing in the air." The very same effect is perceived when we look at objects through spirits and water that are not perfectly mixed, or when we view distant objects over a red-hot poker or over a flame. In all these cases the light suffers refraction in passing from a medium of one density into a medium of a different density, and the refracted rays are constantly changing their direction as the different currents rise in succession. Analogous effects are produced when

sound passes through a mixed medium, whether it consists of two different mediums or of one medium where portions of it have different densities. As sound moves with different velocities through media of different densities, the wave which produces the sound will be partly reflected in passing from one medium to the other, and the direction of the transmitted wave changed; and hence in passing through such media different portions of the wave will reach the ear at different times, and thus destroy the sharpness and distinctness of the sound. This may be proved by many striking facts. If we put a bell in a receiver containing a mixture of hydrogen gas and atmospheric air, the sound of the bell can scarcely be heard. During a shower of rain or of snow, noises are greatly deadened, and when sound is transmitted along an iron wire or an iron pipe of sufficient length, we actually hear two sounds, one transmitted more rapidly through the solid, and the other more slowly through the air. The same property is well illustrated by an elegant and easily repeated experiment of Chladni's. When sparkling champagne is poured into a tall glass till it is half full, the glass loses its power of ringing by a stroke upon its edge, and emits only a disagreeable and a puffy sound. This effect will continue while the wine is filled with bubbles of air, or as long as the effervescence lasts; but when the effervescence begins to subside, the sound becomes clearer and clearer, and the glass rings as usual when the air-bubbles have vanished. If we reproduce the effervescence by stirring the champagne with a piece of bread, the glass will again cease to ring. The same experiment will succeed with other effervescing fluids.

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CHARACTER. — How different is the human mind according to the difference of place! In our passions, as in our creeds, we are the mere dependents on geographical situation. Nay, the trifling variation of a single mile will revolutionise the whole tides and torrents of our hearts. The man who is meek, generous, benevolent, and kind in the country, enters the scene of contest, and becomes fiery or mean, selfish or stern, just as if the virtues were only for solitude and the vices for a city.

## EASTERN RAMBLES AND REMINISCENCES.

### RAMBLE THE TWENTY-THIRD.

GHIZEH—THE CALL TO PRAYER IN THE MORNING—THE CHICKEN-OVENS: THE INTERIOR, THE METHOD OF HATCHING EGGS; HOW THE CHICKENS APPEAR; A CHICKEN'S FIRST APPEARANCE IN PUBLIC; PROFITS OF THE AFFAIR—WEDDING PROCESSION—DONKEY-RACE—THE SLAVE-MARKET; THE SLAVES, AND HOW THEY ARE PURCHASED—CAIRO NOT A VERY ENVIABLE ABODE—PROCESSION BY TORCH AND MOONLIGHT—REFLECTIONS.

"New to my sight, my ravish'd eyes admire  
Each gilded crescent, and each antique spire;  
The marble mosques, beneath whose ample  
domes.  
Fierce warlike sultans sleep in peaceful tombs."  
LADY M. W. MONTAGUE.

EARLY in the morning—about an hour before daybreak—the shrill voices of the blind muezzens, or as they are more properly termed muëddins, were heard calling upon "the faithful" in Ghizeh to pray; and far beyond the precincts of the village they might be heard exclaiming "God is most Great!" "I testify that Mohammed is God's Apostle!" "Come to prayer!" "Prayer is better than sleep!" "There is no Deity but God!" and many other expressions peculiar to the time and place.

The heat, the plagues of a Nile boat, and the shrill voices of the muëddins effectually aroused me, therefore taking a plunge overboard, and a cup of coffee afterwards, I felt refreshed and ready for a visit to the celebrated chicken ovens of Ghizeh, where fowls' eggs are hatched by artificial heat.

Passing through several streets of mud huts we arrived at the building called *maamal el frakh*, which is built of sun-dried bricks, and consists of two rows of small chambers and ovens divided by a narrow vaulted passage, swarming with fleas and oppressively hot. The attendants remain in this passage and watch the process of egg-hatching.

The owners of these establishments (of

which there are upwards of 100 in Lower, and about 60 in Upper Egypt), pave a tax to the government for permission to hatch the eggs.

Each chamber—and there are twelve—is about eight feet long, five or six feet high, and eight feet wide, and is immediately under its oven, so that there are six ovens and six chambers on each side of the passage. All the ovens on each side communicate with one another, and have apertures at the top to allow the smoke to escape occasionally; they have also openings in the floor to communicate with the chambers below.

Our first peep into the gloomy place was not calculated to make a favourable impression. The air was tainted with a disagreeable odour, the heat oppressive, the fleas lively, and in the dark dismal-looking vault beyond, we saw spectre-looking figures striding about, and tossing their arms wildly in the air. Passing the chamber reserved for the attendants, we peeped into the one where the newly hatched chickens are placed, and certainly this was a strange scene; some were asleep and huddled together for warmth or affection, or perhaps both, and yet it can scarcely be supposed that these young foster-chickens, who never knew a tender mother's care, could have any affection for anything but their food, and if we may judge by the powers of deglutition they exhibited, they certainly are a very affectionate race. Some were rehearsing a crow in one corner, under the direction of a thorough-bred coxcomb, who topped the officer over his party, and if we could judge by the discordant sounds around them, the effort was not well received. One unlucky chick had taken up an enviable position, and therefore, forthwith three others attacked him with beak and claws, and he was only rescued from an untimely end by our appearance. The attendant who showed us over the *maamal* threw them some food, and then arose a chorus of *tcheup tcheup*; *tchswEEP tchswEEP*, on all sides. The crowing school broke up, the combatants ceased, the sleepers were aroused, and all were soon too busy to heed anything else but their business of feeding.

We now arrived opposite the door of one of the chambers, which is an aper-





CAIRO BY TORCH AND MOONLIGHT.

ture large enough for a man to get through, and only closed by a straw mat. When the man removed the mat we saw the eggs inside arranged in three rows one above the other, being separated by straw. Looking upwards we saw the aperture in the roof of the chamber, communicating with the oven above, which is heated by a mixture of chopped straw and the excrement of animals made into flat round cakes; and the heat thus maintained is usually about  $100^{\circ}$  of Fahrenheit, but experience alone enables the attendants to

regulate the heat, as they have not any thermometer.

As the eggs we had just seen were only put in the same day, of course there was little to interest us, beyond the method of packing them, therefore we passed on to one of the chambers where the eggs had been twenty-one days, that being the period required to complete the operation of hatching.

The plan generally adopted in the *maamal* is to heat the chambers on one side of the passage, for ten days, and then put out the fires in the ovens above, and heat the chambers on the other side of the passage which are, of course, fresh packed with eggs. The eggs that have been heated for ten days are then removed from the chambers and placed on the floors of the ovens, where the fires have been extinguished. The effect of the whole process is, that in twenty, or twenty-one days the eggs are hatched and the peasants get their chickens.



The process of hatching is generally performed from the latter end (23rd) of February, to the latter end (21th) of April, during which time, from 150,000 to 200,000 eggs are placed in the chambers of each establishment, and produce from 38,900 to 68,000 chickens. The usual plan is for the natives to bring the eggs which they deliver to the proprietor, and he examines them,—if they are good he allows one-half of the number; so that if Hassan brings 200 eggs, he gets 100 chickens. Of course certain seasons prove very unfavourable to the chicken-hatchers, and they lose a great amount of money, but generally by good management and practice, the expenses are few and the profits great. Sudden alternations of temperature affects the success of the venture, extreme heat or cold being highly prejudicial to the chickens.

It is a curious sight to behold a chamber in which the chickens are just coming out like young ladies at their first *soirée*. Before they make their appearance you hear a subdued chirp, which gradually gets louder, and then the shell begins to move, and at last bang goes the beak against it, and the shell giving way, out pops the head of the chick, who really appears overwhelmed with astonishment at the vast number of nodding heads around. Nothing venture, nothing have, thinks Master Chick, and therefore the shell gives way, and forthwith he emerges from durance vile, to show his feathers—for he plumes himself upon his appearance—to the community. Hah! hah! Master Chick, you thought you were mighty strong, a veritable Hercules, but you are mistaken; it is often said pride will have a fall, and therefore you could not expect anything else than to have a capsize over the deserted mansions of your brethren. Take my advice, and do not attempt to walk before thy legs will bear the weight of that odd-shapen body! A hundred eggs roll, they crack, and forthwith a hundred chicken's beaks are protruded; chirp, chirp, chirp, and now the head appears, some push forth their legs and with awkward and shuffling gait, with their shells on their backs, while others quit their houses never to return again.

Good Yousouf inspects the newly-arrived chickens and selects the weak ones

from the strong; the former are placed in the passage and the latter in the chamber, where the rehearsal we witnessed took place. In three or four days the peasants come to claim their brood, and the attendant clears the chamber of the eggs that have not been productive, and then begins to repack them with the fresh supplies.

An experienced Egyptian attendant on a *maamal* detects the good eggs from the bad ones by their heat, and once more the old proverb that there is nothing new under the sun forces itself upon us; for an old Cornish plan of detecting a good from a bad egg is to apply the tongue to the broad end, and if it is warm, the egg is good, but if cold the egg is accounted bad.

As soon as we had seen enough of the *maamal* we proposed returning to our boat, and were about to do so, in fact, we were on our way, when a noise in an adjoining street attracted our attention, and proceeding to the spot we discovered that it was occasioned by a wedding procession.

A wedding at any time is a matter of great interest to the ladies; therefore, I shall for their especial benefit give some slight details of the proceeding.

I cannot enter into all the very interesting and, no doubt necessary, affectionate leave-takings of the ring-nosed mothers and sisters with anklets, &c.; for that part of the ceremony I was not permitted to witness, and shall therefore request my readers to content themselves with filling up the hiatus in the picture by some few imaginative touches, not too highly coloured.

Well then, here begins the noise,—for all weddings must, *per force* (as the Maltese say), be attended by a noise. Here comes a crowd of dirty boys with blue nightgowns—no! they are actually day dresses! Well, I made a mistake and must be pardoned; but all I can say is, that they do look more like night than day dresses—and behind them is a party of musicians (save the word), with a reed-pipe, a hautboy, and a lot of drums. Squeak goes the reed-pipe; whaugh, whaugh, goes the hautboy, and then the drums rattle. The friends behind the musicians grin, and walk in pairs, and behind them young virgins walk two and two, clothed



in white *khaborah's*. Here comes a rose-coloured canopy of gauze, carried by four men, each supporting a pole which sustains the corner of the canopy, and is surmounted by a handsomely embroidered handkerchief. Underneath the canopy is the bride, covered from head to foot with a red cashmere shawl, and her head ornamented with a crown placed over the shawl. She is not alone, for her husband elect and her friends walk within the canopy, and although the heat is intense, yet they appear to like the affair. Shrill cries are heard ever and anon from the women. You appear astonished; but this is a common thing, in fact always expected by the lower orders of the people. The shrill cry, discordant as it is, is a cry of joy, which the women utter on state or favourite occasions, and is called the *zujh areet*. Moore notices the cry in his *Lalla Rookh*, where he writes

"And answer'd by a Ziraleet  
From neighbouring hareem, wild and sweet."

Behind the bride and party you see the friends walking in pairs, and no doubt you also observe that there are two men rattling long staves together behind them ali. These people are engaged to get up a sham fight; perhaps the old game of quarter-staff may have originated with them.

Our curiosity of these customs was soon satisfied, and therefore we once more attempted to reach our boat; I say attempted, because hitherto the effort had been made in vain. This time we succeeded, and having a fair wind, soon arrived at Boulak.

A cup of coffee satisfied myself, but some of the others considered a pipe indispensable to their comfort; and having satisfied themselves with the flavour of the tobacco, they declared a donkey-race to our hotel quite necessary to settle who was to pay the bill, and we therefore at once proceeded to business and by dint of numerous threats and thumps, arrived at our destination in true Blackheath style. There was a dispute about the matter, but as some of us ventured to suggest another race to Boulak and back, the grumblers forthwith paid the amount, and retired to the precincts of our hotel, having discharged the animals biped and quadruped.

After a little refreshment, we went to the mooristan or madhouse of Cairo, which was almost filled with poor suffering beings that seemed to drag out a miserable existence in the wretched place in which they were incarcerated. Their haggard looks, their chains, and wild cries, are enough to appal any one accustomed to such sights; but what must the effect be upon those who have never seen poor sufferers like those before us, writhing in the despair and agony of frenzy, treated like brutes, aye, worse than brutes, and not receiving any sympathy?

We then proceeded to the slave-market,



which is very extensive, and well supplied with slaves. It is a large open court covered with matting, surrounded by a great many small dismal-looking cells, in rows, one over the other. Here the Abyssinian slaves were lodged, and in the centre of the court were groups of negroes squatted on the matting, and various slave-merchants smoking their pipes. Yonder is an old Turk pointing to a young Nubian, well tattooed on the breast and arms, and even on the lips; her head is well greased, for as our Maltese guide expresses himself, "it shines like one new dollar;" and see how proud she is of her large earrings and necklace of great beads. Poor thing! although she is only eight or ten years old, she must perform all the household

drudgery, and do all she can to please her hard-hearted master or mistress. To be sure a female of only eight or ten years of age in the East, is equal to one nearly double that age in England, and we often see them mothers at that age, nursing children.

Look at the old Turk! he has selected the young Nubian, and the slave-merchant is making her jump and run to show that she is sound. Even the slight covering that she had on is removed, to exhibit her shape. He is satisfied, and has paid forty dollars for her; and now she is his.

Let us take a look at the Abyssinians, at the other side of the court. Some of them are certainly handsome, although their complexions are of a yellowish olive, for their languishing dark eyes are rendered even more so by the black from the kohol which is smeared over the edges of the eyelids, and their lips are not so thick as the Nubians, or Dongolians, although thicker than those of Europeans. See what straight noses they have, no short pugs, but respectable long straight ones, that you would not be ashamed of yourself, and fine long black hair, well greased with palm oil. They are better dressed than those in the court, having more clothing, and some even bracelets, anklets, and nose rings. But they look sad, and hang down their heads either in shame or sorrow, for they have been

"Forced from home and all its pleasures."

perhaps by their own relatives. The slave-merchants give a few trashy trinkets for them, and now they will sell for 60 or 100 dollars, perhaps more.

Slavery in the East is not so bad as some persons imagine; because, as the slave is valuable, the owner generally takes more care of his slaves than he does of his servants. Although sometimes they kill them in a fit of passion, yet such instances are rare,—as, in that case, the fit of ill-temper becomes expensive, perhaps costing as much as £20 or £25. The Nubians are generally used for domestic servants; the Abyssinians, Georgians, and Circassians, are purchased for the hareem,—and generally made free as soon as their first son is born. We were not permitted to see the white slave-market, which is close to the other.

Night soon spread her sable mantle o'er Cairo,—this scene of misery, where even a few brief hours hang heavily on one's hands; where mirth and gaiety are seldom heard, unless from noisy Franks; where dogs bark at the moon, untouched and unheeded; where Fanaticism reigns supreme, by day or by night; where hotel-keepers charge what they please; where eyes are less common than dollars, and hearts as unsound as puff-balls; where plague and disease, in most forms, visit your abode by night or by day; and where, in fact, all that is fresh, bright, wholesome and tranquil, are not to be found.

I know not why, but the fact is certain, at the hour when wearied beings give themselves up to the arms of Morpheus, the populace of Cairo turned out to celebrate some event of Kalendaric note. The pale beams of the moon, contrasted with the glare of the torches, as they cast their fitful light on the domed and spired buildings, were beautiful to behold; it was peculiar, and almost awful at that still hour, for,

"Full many a torch and cresset glared"

on the outlines of the surrounding buildings; and the scene, crowded with human beings elate with enthusiastic feelings, was worthy of remembrance.

"How beautiful!

Not the calm beauty of a woodland world,  
Fraught with sweet idleness, and minstrel dreams;

But beauty which awakes the intellect  
More than the feelings; that of power and mind,—  
Man's power,—man's mind!"

A LAST LOOK.—There is a feeling that resembles death in the last glance we are ever to bestow on a loved object. The girl you have treasured in your secret heart as she passes by on her wedding day, it may be, happy and blissful, lifts up her laughing eyes, the symbol of her own light heart, and leaves in that look darkness and desolation to you for ever. The boy your father-spirit has clung to like the very light of your existence, waves his hand from the quarter-deck, as the gigantic ship bends over to the breeze; the tears have dimmed his eyes, for mark! he moves his fingers over them—and this is a last look.



## THE PRIMARY TEACHER.

WE are told that when Sir Robert Peel was quite a child, his father would frequently set him on a table and say, "Now, Robin, make a speech, and I will give you this cherry." The few words stammered out by the little fellow were received as a praiseworthy effort, and he was applauded accordingly. Stimulated by the attention and encouragement thus given, it is said that before "Robin" was ten years of age, he was able to address the company with some considerable degree of eloquence.

It appears that Sir Robert's father designed, from the birth of the child, to educate and train him expressly for a seat in Parliament. With what success the father's project was carried out, requires no recital at this time. The point to which the attention of teachers, and especially *primary teachers*, is called in this incident, is the early age at which the child's education commenced, the assiduous attention and efficient manner by which he was carried forward in his course of training till the great object was attained.

The great secret in this case, well worthy the serious consideration of every parent and teacher, is, that the faculties of mind were early, very early, *pre-occupied* with one leading, controlling object; whereby other less important, perhaps vicious ones, were forestalled. The child may have had all the amusements and childish employments needful for relaxation and enjoyment, yet the great object is at no time to be subordinate to anything else. For many years the boy himself may be almost wholly unconscious of the great object for which his present training is qualifying him; but there is a controlling mind, the father's, which for the present is a substitute, in that respect, for his own, and will withdraw its agency whenever his own shall be able to comprehend and act for itself.

It was, undoubtedly, this pre-occupying of the mind with musical taste, whether it was innate, or very early created, that rendered Mozart, the son of a distinguished musician, a prodigy at three years of age, and conferred upon him an immortal fame in after years. Is it not a fair inference,

that the influence of wise and judicious parents, in impressing a love for truth and all that is good on the infantile mind of Washington, did more to make him what he proved to be, than anything else? On the other hand, who is not painfully convinced, that that child whose appetite was early perverted and pampered with sweetmeats, and whatever could gratify the palate, in whose mind a luxurious style of living became the engrossing theme, till pecuniary embarrassment, as a consequence, led him to crime and an ignominious death, was swept irresistibly along that rapidly-descending current, whose source had been open freely to him through mistaken kindness of friends, while those springs which might have imparted a salutary influence, rendered him an invaluable citizen, and maintained him on a commanding literary and scientific eminence, were for ever sealed to him?

If there be truth in the foregoing, how critical is every step of the first decennary of an intellectual being! Instructed he will be, principles will be established, habits formed; but under whose supervision? It is the object of this article, to call the attention of primary teachers, more particularly, to the great responsibility they assume in performing the duties of "teachers of little children." Too generally the impression prevails that almost anyone is competent to teach little children, but when advanced in age and studies, more competent teachers must be provided. While this may be true, in some respects, it is most seriously important that certain qualifications of the teacher of little children should be of the very highest character, in *all cases*.

A French infidel is said to have asserted, that if he could have the exclusive control of a child during the first *five years* of its life, he could teach it to violate every law of God and man without compunction, ever after.

The teaching of letters, the primary branches of study, are made the first, too often the sole object of school attendance. The requirement of proper deportment usually goes but little further than to meet the convenience of the teacher and school, in conducting the operations of school exercises. But how small a part of the education even of a child is comprehended in this,

if successfully accomplished? Suppose with the increasing strength, mental and physical, the passions become rampant, the desires become uncontrollable, taste perverted, judgment distorted or paralyzed, and the *will* with despotic sway urges each to extremes, of what service will it be that the mind has become more enlightened? Better would it be that such a beast of prey should be enshrouded in midnight darkness, that his victim might escape the notice of his malignant eye.

One of the very highest qualifications, then, of a primary teacher, consists in an ability to cultivate right affections, regulate the desires, form proper habits of action, associate in a proper manner with companions, and manifest becoming respect to superiors; in short, to teach the child how to *think and act right under all possible circumstances*. Then, how easy to engraft anything desirable upon such a character! The farmer who should sow his grain on ground unprepared for its reception, would scarcely expect an abundant crop from the sickly blades, struggling amidst the luxuriant weeds overshadowing them.

Experience seems to prove more and more clearly every day, that dulness in learning, disinclination to mental effort and improvement, spring, in most cases, from injudicious management of the child in its earliest stages of life, by parents first, and next by its first teacher.

At the outset care is not taken to present proper objects in a suitable manner so as to *preoccupy* the mind, and give it bent in a right direction. What a vast majority of minds of children are left to be formed at hazard, by the thousand occurrences of each day, just as they may chance to meet the desires of the child? Is it a matter of wonder, then, after being accustomed for a time to receive or reject external influences at pleasure, that he should reject the influences of his teacher when they fail to correspond with his wishes?

The parent is first to give right impressions, and as the teacher stands for the time "*in loco parentis*," must receive the charge from the parents' hands with all due care, and feeling of responsibility. Further than this, if it is not the teacher's duty to make amends, so far as may be,

for the neglect, ignorance, or incompetency of parents, upon whom may or can it fall?

### THE FIRST INFANT SCHOOL.

WILDERSPIN, the originator of infant schools, gives an amusing account of his first attempt at managing a school full of infants. He and his wife dreaded the day of opening, and they found it truly dreadful. "When the mothers were gone, it was arduous work to keep the little things entertained and beguiled at all. At last, one child cried aloud; two or three more caught the lamentation, which spread by infection, till every infant of the whole crowd was roaring as loud as it could roar. After vain attempts to pacify them, in utter despair about the children, and horror at the effect upon the whole neighbourhood, the worthy couple rushed from the school-room into the next chamber, when the wife sank in tears upon the bed. Her husband was no less wretched; this din of woe was maddening; something must be done—but what? In the freakishness of despair, he seized a pole, and put on the top of it a cap of his wife's which was drying from the wash-tub. He rushed back into the school-room, waving his new apparatus of instruction—giving, as he found, his first lesson on Objects. The effect which ensued was *his* lesson. In a minute not a child was crying. All eyes were fixed upon the cap; all tears stood still and dried upon all cheeks. The wife now joined him; and they kept the children amused, and the neighbours from storming the doors, till the clock struck twelve. A momentary joy entered the hearts of the Wilderspains at the sound; but it died away as they sunk down exhausted, and asked each other, with faces of dismay, whether they were to go through this again in the afternoon, and every day." They soon, however, reduced the thing to a system, and their task became first endurable, and at length agreeable.

WIT must describe its proper circumference, and not go beyond it, lest, like little boys when they straggle out of their own parish, it may wander to places where it is not known, and be lost.—*Steele*.



# POPULAR ASTRONOMY.

## LETTER IX.

### TERRESTRIAL GRAVITY.

“ To Him no high, no low, no great, no small,  
He fills, He bounds, connects, and equals all.”—*Pope.*

WE discover in Nature a tendency of every portion of matter towards every other. This tendency is called *gravitation*. In obedience to this power, a stone falls to the ground, and a planet revolves around the sun. We may contemplate this subject, as it relates either to phenomena that take place near the surface of the earth, or in the celestial regions. The former, *gravity*, is exemplified by falling bodies; the latter, *universal gravitation*, by the motions of the heavenly bodies. The laws of terrestrial gravity were first investigated by Galileo; those of universal gravitation, by Sir Isaac Newton. Terrestrial gravity is only an individual example of universal gravitation; being the tendency of bodies towards the centre of the earth. We are so much accustomed, from our earliest years, to see bodies fall to the earth, that we imagine bodies must of necessity fall “downwards;” but when we reflect that the earth is round, and that bodies fall towards the centre on all sides of it, and that of course bodies on opposite sides of the earth fall in precisely opposite directions, and towards each other, we perceive that there must be some force acting to produce this effect; nor is it enough to say, as the ancients did, that bodies “naturally” fall to the earth. Every motion implies some force which produces it; and the fact that bodies fall towards the earth, on all sides of it, leads us to infer that that force, whatever it is, resides in the earth itself. We therefore call it *attraction*. We do not, however, say what attraction *is*, but what it *does*. We must bear in mind, also, that, according to the third law of motion, this attraction is mutual; that when a stone falls towards the earth, it exerts the same force on the earth that the earth exerts on the stone; but the motion of the earth towards the stone, is as much less than that of the stone towards the earth, as its quantity of matter is greater; and therefore its motion is quite insensible.

But although we are compelled to acknowledge the *existence* of such a force as gravity, causing a tendency in all bodies towards each other, yet we know nothing of its *nature*, nor can we conceive by what medium bodies at such a distance as the moon and the earth exercise this influence on each other. Still, we may trace the modes in which this force acts; that is, its *laws*; for the laws of Nature are nothing else than the modes in which the powers of Nature act.

We owe chiefly to the great Galileo the first investigation of the laws of terrestrial gravity, as exemplified in falling bodies; and I will avail myself of this opportunity to make you better acquainted with one of the most interesting of men and greatest of philosophers.

Galileo was born at Pisa, in Italy, in the year 1564. He was the son of a Florentine nobleman, and was destined by his father for the medical profession, and to this his earlier studies were devoted. But a fondness and a genius for mechanical inventions had developed itself, at a very early age, in the construction of his toys, and a love of drawing; and as he grew older, a passion for mathematics, and for experimental research, predominated over his zeal for the study of medicine, and he fortunately abandoned that for the more congenial pursuits of natural philosophy and astronomy. In the twenty-fifth year of his age, he was appointed, by the Grand Duke of Tuscany, professor of mathematics in the University of Pisa. At that period, there prevailed in all the schools a most extraordinary reverence for the writings of Aristotle, the preceptor of Alexander the Great,—a philosopher who flourished in Greece, about three hundred years before the Christian era. Aristotle, by his great genius and learning, gained a wonderful ascendancy over the minds of men, and

became the oracle of the whole reading world for twenty centuries. It was held, on the one hand, that all truths worth knowing were contained in the writings of Aristotle; and, on the other, that an assertion which contradicted anything in Aristotle could not be true. But Galileo had a greatness of mind which soared above the prejudices of the age in which he lived, and dared to interrogate Nature by the two great and only successful methods of discovering her secrets,—experiment and observation. Galileo was indeed the first philosopher that ever fully employed experiments as the means of learning the laws of Nature, by imitating on a small what she performs on a great scale, and thus detecting her modes of operation. Archimedes, the great Sicilian philosopher, had in ancient times introduced mathematical or geometrical reasoning into natural philosophy; but it was reserved for Galileo to unite the advantages of both mathematical and experimental reasonings in the study of Nature,—both sure, and the only sure, guides to truth, in this department of knowledge, at least. Experiment and observation furnish materials upon which geometry builds her reasonings, and from which she derives many truths that either lie for ever hidden from the eye of observation, or which it would require ages to unfold.

This method of interrogating Nature by experiment and observation, was matured into a system by Lord Bacon, a celebrated English philosopher, early in the seventeenth century,—indeed, during the life of Galileo. Previous to that time, the inquirers into Nature did not open their eyes to see how the facts really *are*; but, by metaphysical processes, in imitation of Aristotle, determined how they *ought to be*, and hastily concluded that they were so. Thus, they did not study into the laws of motion, by observing how motion actually takes place, under various circumstances, but first, in their closets, constructed a definition of motion, and thence inferred all its properties. The system of reasoning respecting the phenomena of Nature, introduced by Lord Bacon, was this: in the first place, to examine all the facts of the case, and then from these to determine the laws of Nature. To derive general conclusions from the comparison of a great number of individual instances constitutes the peculiarity of the Baconian philosophy. It is called the *inductive* system, because its conclusions were built, on the induction, or comparison, of a great many single facts. Previous to the time of Lord Bacon, hardly any insight had been gained into the causes of natural phenomena, and hardly one of the laws of Nature had been clearly established, because all the inquirers into Nature were upon a wrong road, groping their way through the labyrinth of error. Bacon pointed out to them the true path, and held before them the torch-light of experiment and observation, under whose guidance all successful students of Nature have since walked and by whose illumination they have gained so wonderful an insight into the mysteries of the natural world.

It is a remarkable fact, that two such characters as Bacon and Galileo should appear on the stage at the same time, who, without any communication with each other, or perhaps without any personal knowledge of each other's existence, should have each developed the true method of investigating the laws of Nature. Galileo practised what Bacon only taught; and some, therefore, with much reason, consider Galileo as a greater philosopher than Bacon. "Bacon," says Hume, "pointed out, at a great distance the road to philosophy; Galileo both pointed it out to others, and made, himself, considerable advances in it. The Englishman was ignorant of geometry; the Florentine revived that science, excelled in it, and was the first who applied it together with experiment, to natural philosophy. The former rejected, with the most positive disdain, the system of Copernicus; the latter fortified it with new proofs, derived both from reason and the senses."

When we reflect that geometry is a science built upon self-evident truths, and that all its conclusions are the result of pure demonstration, and can admit of no controversy; when we further reflect, that experimental evidence rests on the testimony of the senses, and we infer a thing to be true because we actually see it to be so; it shows us the extreme bigotry, the darkness visible, that beclouded the human intellect,



when it not only refused to admit conclusions first established by pure geometrical reasoning, and afterwards confirmed by experiments exhibited in the light of day, but instituted the most cruel persecutions against the great philosopher who first proclaimed these truths. Galileo was hated and persecuted by two distinct bodies of men, both possessing great influence in their respective spheres,—the one consisting of the learned doctors of philosophy who did nothing more, from age to age, than reiterate the doctrines of Aristotle, and were consequently alarmed at the promulgation of principles subversive of those doctrines; the other consisting of the Romish priesthood, comprising the terrible Inquisition, who denounced the truths taught by Galileo, as inconsistent with certain declarations of the Holy Scriptures. We shall see, as we advance, what a fearful warfare he had to wage against these combined powers of darkness.

Aristotle had asserted, that, if two different weights of the same material were let fall from the same height, the heavier one would reach the ground sooner than the other, in proportion as it was more weighty. For example: if a ten-pound leaden weight and a one pound were let fall from a given height at the same instant, the former would reach the ground ten times as soon as the latter. No one thought of making the trial, but it was deemed sufficient that Aristotle had said so; and accordingly this assertion had long been received as an axiom in the science of motion. Galileo ventured to appeal from the authority of Aristotle to that of his own senses, and maintained, that both weights would fall in the same time. The learned doctors ridiculed the idea. Galileo tried the experiment in their presence, by letting fall, at the same instant, large and small weights from the top of the celebrated leaning tower of Pisa. Yet, with the sound of the two weights clicking upon the pavement at the same moment, they still maintained that the ten-pound weight would reach the ground in one tenth part of the time of the other, because they could quote the chapter and verse of Aristotle where the fact was asserted. Wearied and disgusted with the malice and folly of these Aristotelian philosophers, Galileo, at the age of twenty-eight, resigned his situation in the university of Pisa, and removed to Padua, in the university of which place he was elected professor of mathematics. Up to this period, Galileo had devoted himself chiefly to the studies of the laws of motion, and the other branches of mechanical philosophy. Soon afterwards, he began to publish his writings, in rapid succession, and became at once among the most conspicuous of his age,—a rank which he afterwards well sustained and greatly exalted, by the invention of the telescope, and by his numerous astronomical discoveries. I will reserve an account of these great achievements until we come to that part of astronomy to which they were more immediately related, and proceed, now, to explain to you the leading principles of *terrestrial gravity*, as exemplified in falling bodies.

First, *all bodies near the earth's surface fall in straight lines towards the centre of the earth.*—We are not to infer from this fact, that there resides at the centre any peculiar force, as a great loadstone, for example, which attracts bodies towards itself; but bodies fall towards the centre of the sphere, because the combined attractions of all the particles of matter in the earth, each exerting its proper force upon the body, would carry it towards the centre. This may be easily illustrated by a diagram. Let B, Fig. 29, page 124, be the centre of the earth, and A a body without it. Every portion of matter in the earth exerts some force on A, to draw it down to the earth. But since there is just as much matter on one side of the line A B, as on the other side, each half exerts an equal force to draw the body towards itself; therefore it falls in the direction of the diagonal between the two forces. Thus, if we compare the effects of any two particles of matter at equal distances from the line A B, but on opposite sides of it, as *a*, *b*, while the force of the particle at *a* would tend to draw A in the direction of A *a*, that of *b* would draw it in the direction of A *b*, and it would fall in the line A B, half way between the two. The same would hold true of any other two corresponding particles of matter on different sides of the earth, in respect to a body situated in any place without it.

Secondly, *all bodies fall towards the earth, from the same height, with equal velocities.*

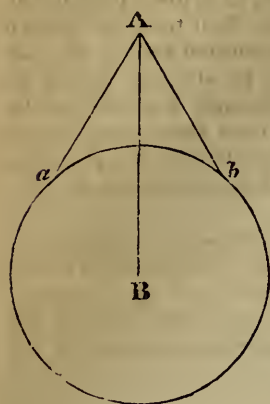


Fig. 29.

A musket-ball, and the finest particle of down, if let fall from a certain height towards the earth, tend to descend towards it, at the same rate, and would proceed with equal speed, were it not for the resistance of the air, which retards the down more than it does the ball, and finally stops it. If, however, the air be removed out of the way, as it may be by means of the air-pump, the two bodies keep side by side in falling from the greatest height at which we can try the experiment.

Thirdly, *bodies, in falling towards the earth, have their rate of motion continually accelerated.*—Suppose we let fall a musket-ball from the top of a high tower, and watch its progress, disregarding the resistance of the air: the first second, it will pass over sixteen feet and one inch, but its speed will be constantly increased, being all the while urged onward by the same force, and retaining all that it has already acquired; so that the longer it is in falling, the swifter

its motion becomes. Consequently, when bodies fall from a great height, they acquire an immense velocity before they reach the earth. Thus, a man falling from a balloon, or from the mast-head of a ship, is broken in pieces; and those meteoric stones, which sometimes fall from the sky, bury themselves deep in the earth. On measuring the spaces through which a body falls, it is found, that it will fall four times as far in two seconds as in one, and one hundred times as far in ten seconds as in one; and universally, the space described by a falling body is proportioned to the time multiplied into itself, that is, to the square of the time.

Fourthly, *gravity is proportioned to the quantity of matter.*—A body which has twice as much matter as another exerts a force of attraction twice as great, and also receives twice as much from the same body as it would do, if it were only just as heavy as that body. Thus the earth, containing, as it does, forty times as much matter as the moon, exerts upon the moon forty times as much force as it would do, were its mass the same with that of the moon; but it is also capable of receiving forty times as much gravity from the moon as it would do, were its mass the same as the moon's; so that the power of attracting and that of being attracted are reciprocal; and it is therefore correct to say, that the moon attracts the earth *just as much as* the earth attracts the moon; and the same may be said of any two bodies, however different in quantity of matter.

Fifthly, *gravity, when acting at a distance from the earth, is not as intense as it is near the earth.*—At such a distance as we are accustomed to ascend above the general level of the earth, no great difference is observed. On the tops of high mountains, we find bodies falling towards the earth, with nearly the same speed as they do from the smallest elevations. It is found, nevertheless, that there is a real difference; so that, in fact, the weight of a body (which is nothing more than the measure of its force of gravity) is not quite so great on the tops of high mountains as at the general level of the sea. Thus, a thousand pounds' weight, on the top of a mountain half a mile high would weigh a quarter of a pound less than at the level of the sea; and if elevated four thousand miles above the earth,—that is *twice as far* from the centre of the earth as the surface is from the centre,—it would weigh only one-fourth as much as before; if *three times as far*, it would weigh only one-ninth as much. So that the force of gravity decreases, as we recede from the earth, in the same proportion as the square of the distance increases. This fact is generalized by saying, that *the force of gravity, at different distances from the earth, is inversely as the square of the distance.*

Were a body to fall from a great distance,—suppose a thousand times that of the radius of the earth,—the force of gravity being one million times less than that at the surface of the earth, the motion of the body would be exceedingly slow, carrying it over the sixth part of an inch in a day. It would be a long time, therefore, in



making any sensible approaches towards the earth; but at length, as it drew near to the earth it would acquire a very great velocity, and would finally rush towards it with prodigious violence. Falling so far, and being continually accelerated on the way, we might suppose that it would at length attain a velocity infinitely great; but it can be demonstrated, that, if a body were to fall from an infinite distance, attracted to the earth only by gravity, it could never acquire a velocity greater than about seven miles per second. This, however, is a speed inconceivably great, being about eighteen times the greatest velocity that can be given to a cannon-ball, and more than twenty-five thousand miles per hour.

But the phenomena of falling bodies must have long been observed, and their laws had been fully investigated by Galileo and others, before the cause of their falling was understood, or any such principle as gravity, inherent in the earth and in all bodies, was applied to them. The development of this great principle was the work of Sir Isaac Newton; and I will give you, in my next Letter, some particulars respecting the life and discoveries of this wonderful man.

### LETTER X.

#### SIR ISAAC NEWTON—UNIVERSAL GRAVITATION—FIGURE OF THE EARTH'S ORBIT—PRECESSION OF THE EQUINOXES.

"The heavens are all his own; from the wild rule  
Of whirling vortices, and circling spheres,  
To their first great simplicity restored,  
The schools astonish'd stood; but found it vain  
To combat long with demonstration clear,  
And, unawaken'd, dream beneath the blaze  
Of truth. At once their pleasing visions fled,  
With the light shadows of the morning mix'd,  
When Newton rose, our philosophic sun."—*Thomson's Elegy.*

SIR ISAAC NEWTON was born in Lincolnshire, England, in 1642, just one year after the death of Galileo. His father died before he was born, and he was a helpless infant, of a diminutive size, and so feeble a frame, that his attendants hardly expected his life for a single hour. The family dwelling was of humble architecture, situated in a retired but beautiful valley, and was surrounded by a small farm, which afforded but a scanty living to the widowed mother and her precious charge.

The boyhood of Newton was distinguished chiefly for his ingenious mechanical contrivances. Among other pieces of mechanism, he constructed a windmill so curious and complete in its workmanship, as to excite universal admiration. After carrying it a while by the force of the wind, he resolved to substitute animal power; and for this purpose he inclosed in it a mouse, which he called a miller, and which kept the mill a-going by acting on a tread-wheel. The power of the mouse was brought into action by unavailing attempts to reach a portion of corn placed above the wheel. A water-clock, a four-wheeled carriage propelled by the rider himself, and kites of superior workmanship, were among the productions of the mechanical genius of this gifted boy. At a little later period, he began to turn his attention to the motions of the heavenly bodies, and constructed several sun-dials on the walls of the house where he lived. All this was before he had reached his fifteenth year. At this age, he was sent by his mother, in company with an old family servant, to a neighbouring market-town, to dispose of products of their farm, and to buy articles of merchandise for their family use; but the young philosopher left all these negotiations to his worthy partner, occupying himself, meanwhile, with a collection of old books, which he had found in a garret. At other times, he stopped on the road, and took shelter with his book under a hedge, until the servant returned. They endeavoured to educate him as a farmer; but the perusal of a book, the construction of a water-mill, or some other mechanical or scientific amusement, absorbed all his thoughts, when the sheep were going astray, and the cattle were devouring or treading down the corn. One of his uncles having found him one day under a hedge, with a book in his hand, and entirely absorbed in meditation, took it from him, and found that it was a mathematical

problem which so engrossed his attention. His friends, therefore, wisely resolved to favour the bent of his genius, and removed him from the farm to the school, to prepare for the university. In the eighteenth year of his age, Newton was admitted into Trinity College, Cambridge. He made rapid and extraordinary advances in the mathematics, and soon afforded unequivocal presages of that greatness which afterwards placed him at the head of the human intellect. In 1669, at the age of twenty-seven, he became professor of mathematics at Cambridge, a post which he occupied for many years afterwards. During the four or five years previous to this he had, in fact, made most of those great discoveries which have immortalized his name. We are at present chiefly interested in one of these, namely, that of *universal gravitation*; and let us see by what steps he was conducted to this greatest of scientific discoveries.

In the year 1666, when Newton was about twenty-four years of age, the plague was prevailing at Cambridge, and he retired into the country. One day, while he sat in a garden, musing on the phenomena of Nature around him, an apple chanced to fall to the ground. Reflecting on the mysterious power that makes all bodies near the earth fall towards its centre, and considering that this power remains unimpaired at considerable heights above the earth, as on the tops of trees and mountains, he asked himself,—“May not the same force extend its influence to a great distance from the earth, even as far as the moon? Indeed, may not this be the very reason, why the moon is drawn away continually from the straight line in which every body tends to move, and is thus made to circulate around the earth?” You will recollect that it was mentioned, in my Letter which contained an account of the first law of motion, that if a body is put in motion by any force, it will always move forward in a straight line, unless some other force compels it to turn aside from such a direction; and that, when we see a body moving in a curve, as a circular orbit, we are authorized to conclude that there is some force existing within the circle, which continually draws the body away from the direction in which it tends to move. Accordingly, it was a very natural suggestion, to one so well acquainted with the laws of motion as Newton, that the moon should constantly bend towards the earth, from a tendency to fall towards it, as any other heavy body would do, if carried to such a distance from the earth. Newton had already proved, that if such a power as gravity extends from the earth to distant bodies, it must decrease, as the square of the distance from the centre of the earth increases; that is, at double the distance, it would be four times less; at ten times the distance, one hundred times less; and so on. Now, it was known that the moon is about sixty times as far from the centre of the earth as the surface of the earth is from the centre, and consequently, the force of attraction at the moon must be the square of sixty, or thirty-six hundred times less than it is at the earth; so that a body at the distance of the moon would fall towards the earth very slowly, only one thirty-six hundredth part as far in a given time, as at the earth. Does the moon actually fall towards the earth at this rate; or, what is the same thing, does she depart at this rate continually from the straight line in which she tends to move, and in which she would move, if no external force diverted her from it? On making the calculation, such was found to be the fact. Hence gravity, and no other force than gravity, acts upon the moon, and compels her to revolve around the earth. By reasonings equally conclusive, it was afterwards proved, that a similar force compels all the planets to circulate around the sun; and now, we may ascend from the contemplation of this force, as we have seen it exemplified in falling bodies, to that of a universal power whose influence extends to all the material creation. It is in this sense that we recognise the principle of universal gravitation, the law of which may be thus enunciated; *all bodies in the universe, whether great or small, attract each other, with forces proportioned to their respective quantities of matter, and inversely as the square of their distances from each other.*

This law asserts,—first, that attraction reigns throughout the material world, affecting alike the smallest particle of matter and the greatest body; secondly, that it acts upon every mass of matter, precisely in proportion to its quantity; and, thirdly, that its intensity is diminished as the square of the distance is increased.



Observation has fully confirmed the prevalence of this law throughout the solar system; and recent discoveries among the fixed stars, to be more fully detailed hereafter, indicate that the same law prevails there. The law of universal gravitation is therefore held to be the grand principle which governs all the celestial motions. Not only is it consistent with all the observed motions of the heavenly bodies, even the most irregular of those motions, but, when followed out into all its consequences, it would be competent to assert that such irregularities must take place, even if they had never been observed.

Newton first published the doctrine of universal gravitation in the "Principia," in 1687. The name implies that the work contains the fundamental principles of natural philosophy and astronomy. Being founded upon the immutable basis of mathematics, its conclusions must of course be true and unalterable, and thenceforth we may regard the great laws of the universe as traced to their remotest principle. The greatest astronomers and mathematicians have since occupied themselves in following out the plan which Newton began, by applying the principles of universal gravitation to all the subordinate as well as to the grand movements of the spheres. This great labour has been especially achieved by La Place, a French mathematician of the highest eminence, in his profound work, the "Mecanique Celeste." Of this work, our distinguished countryman, Dr. Bowditch, has given a magnificent translation, and accompanied it with a commentary, which both illustrates the original, and adds a great amount of matter hardly less profound than that.

We have thus far taken the earth's orbit around the sun as a great circle, such being its projection on the sphere constituting the celestial ecliptic. The real path of the

earth around the sun is learned, as I before explained to you, by the apparent path of the sun around the earth once a year. Now, when a body revolves about the earth at a great distance from us, as is the case with the sun and moon, we cannot certainly infer that it moves in a circle because it appears to describe a circle on the face of the sky, for such might be the appearance of its orbit, were it ever so irregular a curve. Thus, if E, Fig. 30, represents the earth, and A C B,

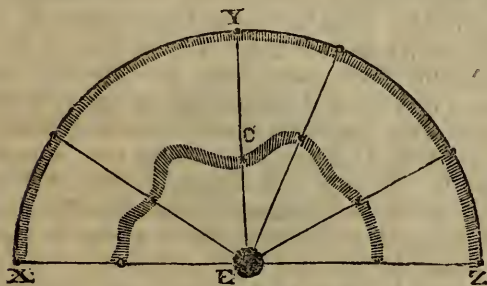


Fig. 30.

the irregular path of a body revolving about since, since we should refer the body continually to some place on the celestial sphere,  $X Y Z$ , determined by lines drawn from the eye to the concave sphere through the body,—the body, while moving from  $A$  to  $B$  through  $C$ , would appear to move from  $X$  to  $Z$ , through  $Y$ . Hence, we must determine from other circumstances than the actual appearance, what is the true figure of the orbit.

Were the earth's path a circle, having the sun in the centre, the sun would always appear to be at the same distance from us; that is, the radius of the orbit, or *radius vector*, (the name given to a line drawn from the centre of the sun to the orbit of any planet), would always be of the same length. But the earth's distance from the sun is constantly varying, which shows that its orbit is not a circle. We learn the true figure of the orbit, by ascertaining the *relative distances* of the earth from the sun, at various periods of the year. These distances all being laid down in a diagram, according to their respective lengths, the extremities, on being connected, give us our first idea of the shape of the orbit, which appears of an oval form, and at least resembles an ellipse; and, on further trial, we find that it has the properties of an ellipse. Thus, let  $E$ , Fig. 32, be the place of the earth, and  $a, b, c$ , &c., successive positions of the sun; the *relative lengths* of the lines  $E a, E b$ , &c., being known, on connecting the points  $a, b, c$ , &c., the resulting figure indicates the true figure of the earth's orbit.

These relative distances are found in two different ways; first, *by changes in the*

sun's apparent diameter; and, secondly, by variations in his angular velocity. The

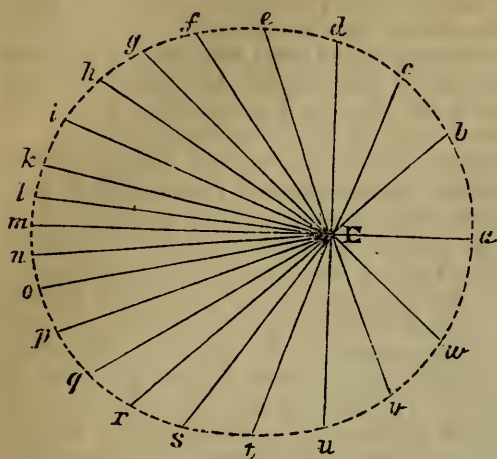


Fig 31.

same object appears to us smaller in proportion as it is more distant; and if we see a heavenly body varying in size, at different times, we infer that it is at different distances from us; that when largest, it is nearest us, and when smallest, furthest off. Now, when the sun's diameter is accurately measured by instruments, it is found to vary from day to day; being, when greatest, more than thirty-two minutes and a half, and when smallest, only thirty-one minutes and a half, — differing, in all, about seventy-five seconds. When the diameter is greatest, which happens in January, we know that the sun is nearest to us; and when the diameter is least, which occurs in July, we infer that the sun is at the greatest distance from us. The point where the earth, or any planet, in its revolution, is nearest the sun, is called its *perihelion*; the point where it is furthest from the sun, its *aphelion*. Suppose, then, that, about the first of January, when the diameter of the sun is greatest, we draw a line, *E a*, Fig. 31, to represent it, and afterwards, every ten days, draw other lines, *E b*, *E c*, &c.; increasing in the same ratio as the apparent diameters of the sun decrease. These lines must be drawn at such a distance from each other, that the triangles, *E a b*, *E b c*, &c., shall be all equal to each other, for a reason that will be explained hereafter. On connecting the extremities of these lines, we shall obtain the figure of the earth's orbit.

Similar conclusions may be drawn from observations on the sun's *angular velocity*. A body appears to move most rapidly when nearest to us. Indeed, the apparent velocity increases rapidly, as it approaches us, and as rapidly diminishes, when it recedes from us. If it comes twice as near as before, it appears to move not merely twice as swiftly, but four times as swiftly; if it comes ten times nearer, its apparent velocity is one hundred times as great as before. We say, therefore, that the velocity varies inversely as the square of the distance; for, as the distance is diminished ten times, the velocity is increased the square of ten; that is, one hundred times. Now, by noting the time it takes the sun, from day to day, to cross the central wire of the transit-instrument, we learn the comparative velocities with which it moves at different times; and from these we derive the comparative distances of the sun at the corresponding times; and laying down these relative distances in a diagram, as before, we get our first notions of the actual figure of the earth's orbit, or the path which it describes in its annual revolution around the sun.

Having now learned the fact, that the earth moves around the sun, not in a circular but in an elliptical orbit, you will desire to know by what forces it is impelled, to make it describe this figure, with such uniformity and constancy, from age to age. It is commonly said, that gravity causes the earth and the planets to circulate around the sun; and it is true that it is gravity which turns them aside from the straight line in which, by the first law of motion, they tend to move, and thus causes them to revolve around the sun. But what force is that which gave to them this original impulse, and impressed upon them such a tendency to move forward in a straight line? The name *projectile force* is given to it, because it is the same as though the earth were originally projected into space, when first created; and therefore its motion is the result of two forces, the projectile force, which would cause it to move forward in a straight line which is a tangent to its orbit, and gravitation, which bends it towards the sun. But before you can clearly understand the nature of this motion, and the action of the



two forces that produce it, I must explain to you a few elementary principles upon which this and all the other planetary motions depend.

You have already learned, that when a body is acted on by two forces, in different directions, it moves in the direction of neither, but in some direction between them. If I throw a stone horizontally, the attraction of the earth will continually draw it downward, out of the line of direction in which it was thrown, and make it descend to the earth in a curve. The particular form of the curve will depend on the velocity with which it is thrown. It will always *begin* to move in the line of direction in which it is projected; but it will soon be turned from that line towards the earth. It will, however, continue nearer to the line of projection in proportion as the velocity of projection is greater. Thus, let A C, Fig. 32, be perpendicular to the horizon, and A B

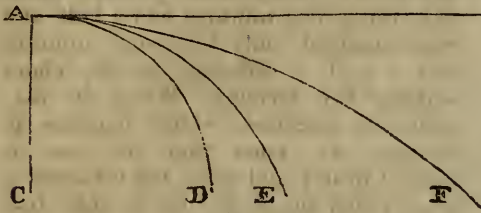


Fig. 32.

parallel to it, and let a stone be thrown from A, in the direction of A B. It will, in every case, commence its motion in the line A B, which will therefore be a tangent to the curve it describes; but, if it is thrown with a small velocity, it will soon depart from the tangent, describing the line A D; with a greater velocity, it will describe a curve nearer the tangent, as A E; and with a still greater velocity, it will describe the curve A F.

As an example of a body revolving in an orbit under the influence of two forces, suppose a body placed at any point, P, Fig. 33, above the surface of the earth, and let

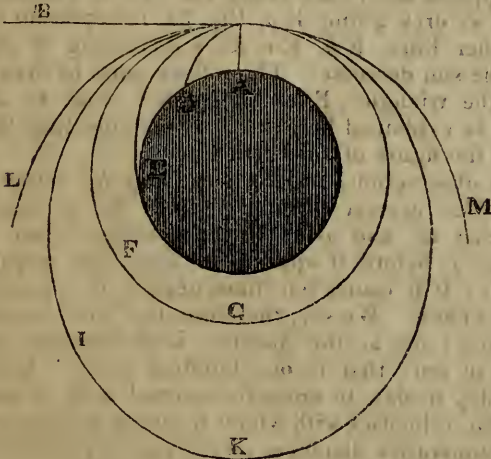


Fig. 33.

quite round the earth, and return again to P, describing the circle P F G. With a velocity of projection still greater, it would describe an ellipse, P I K; and if the velocity be increased to a certain degree, the figure becomes a parabola, L P M,—a curve which never returns into itself.

In Fig. 34, page 130, suppose the planet to have passed the point C, at the aphelion, with so small a velocity, that the attraction of the sun bends its path very much, and causes it immediately to begin to approach towards the sun. The sun's attraction will increase its velocity, as it moves through D, E, and F, for the sun's attractive force on the planet, when at D, is acting in the direction D S; and, on account of the small angle made between D E and D S, the force acting in the line D S helps the planet forward in the path D E, and thus increases its velocity. In like manner the velocity of the planet will be continually increasing as it passes through D, E, and F; and though the attractive force, on account of the planet's nearness, is so much increased, and tends, therefore, to make the orbit more curved, yet the velocity is also so much increased, that the orbit is not more curved than before; for the same increase of

velocity, occasioned by the planet's approach to the sun, produces a greater increase of

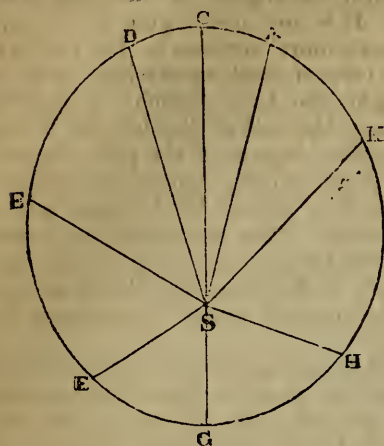


Fig. 54.

centrifugal force, which carries it off again. We may see, also, the reason why, when the planet has reached the most distant part of its orbit, it does not entirely fly off, and never return to the sun; for, when the planet passes along K, H, A, the sun's attraction retards the planet, just as gravity retards a ball rolled up-hill; and when it has reached C, its velocity is very small, and the attraction to the centre of force causes a great deflection from the tangent, sufficient to give its orbit a great curvature, and the planet wheels about, returns to the sun, and goes over the same orbit again. As the planet recedes from the sun, its centrifugal force diminishes faster than the force of gravity, so that the latter finally preponderates.

I shall conclude what I have to say at present, respecting the motion of the earth around the sun, by adding a few words respecting the precession of the equinoxes.

The *precession of the equinoxes* is a slow but continual shifting of the equinoctial points, from east to west. Suppose that we mark the exact place in the heavens where, during the present year, the sun crosses the equator, and that this point is close to a certain star; next year, the sun will cross the equator a little way westward of that star, and so every year, a little further westward, until, in a long course of ages, the place of the equinox will occupy successively every part of the ecliptic, until we come round to the same star again. As, therefore, the sun revolving from west to east, in his apparent orbit, comes round to the point where it left the equinox, it meets the equinox before it reaches that point. The appearance is as though the equinox *goes forward* to meet the sun, and hence the phenomenon is called the *precession* of the equinoxes; and the fact is expressed by saying, that the equinoxes retrograde on the ecliptic, until the line of the equinoxes (a straight line drawn from one equinox to the other) makes a complete revolution, from east to west. This is of course a retrograde motion, since it is contrary to the order of the signs. The equator is conceived as *sliding* westward on the ecliptic, always preserving the same inclination to it, as a ring, placed at a small angle with another of nearly the same size which remains fixed, may be slid quite around it, gives a corresponding motion to the two points of intersection. It must be observed, however, that this mode of conceiving of the precession of the equinoxes is purely imaginary, and is employed merely for the convenience of representation.

The amount of precession annually is fifty seconds and one tenth; whence, since there are thirty-six hundred seconds in a degree, and three hundred and sixty degrees in the whole circumference of the ecliptic, and consequently one million, two hundred and ninety-six seconds, this sum, divided by fifty seconds, and one tenth, gives twenty-five thousand eight hundred and sixty-eight years for the period of a complete revolution of the equinoxes.

Suppose we now fix to the centre of each of the two rings, before mentioned, a wire representing its axis, one corresponding to the axis of the ecliptic, the other to that of the equator, the extremity of each being the pole of its circle. As the ring denoting the equator, turns round on the ecliptic, which, with its axis, remains fixed, it is easy to conceive that the axis of the equator revolves around that of the ecliptic, and the pole of the equator around the pole of the ecliptic, and constantly at a distance equal to the inclination of the two circles. To transfer our conceptions to the celestial sphere, we may easily see that the axis of the diurnal sphere (that of the earth produced) would not have its pole constantly in the same place among the stars, but that this pole would perform a slow revolution around the pole of the ecliptic, from east to west, completing the circuit in about twenty-six thousand years. Hence



the star which we now call the pole-star has not always enjoyed that distinction, nor will it always enjoy it, hereafter. When the earliest catalogues of the stars were made, this star was twelve degrees from the pole. It is now one degree twenty-four minutes, and will approach still nearer; or, to speak more accurately, the pole will come still nearer to this star, after which it will leave it, and successively pass by others. In about thirteen thousand years the bright star Lyra (which lies near the circle in which the pole of the equator revolves about the pole of the ecliptic, on the side opposite to the present pole-star) will be within five degrees of the pole, and will constitute the pole-star. As Lyra now passes near our zenith, you might suppose that the change of position of the pole among the stars would be attended with a change of altitude of the north pole above the horizon. This mistaken idea is one of the many misapprehensions which result from the habit of considering the horizon as a fixed circle in space. However the pole might shift its position in space, we should still be at the same distance from it, and our horizon would always reach the same distance beyond it.

The time occupied by the sun, in passing from the equinoctial point round to the same point again, is called the *tropical year*. As the sun does not perform a complete revolution in this interval, but falls short of it fifty seconds and one tenth, the tropical year is shorter than the sidereal by twenty minutes and twenty seconds, in mean solar time, this being the time of describing an arc of fifty seconds and one tenth, in the annual revolution.

The changes produced by the precession of the equinoxes, in the apparent places of the circumpolar stars, have led to some interesting results in *chronology*. In consequence of the retrograde motion of the equinoctial points, the *signs* of the ecliptic do not correspond, at present, to the *constellations* which bear the same names, but lie about one sign, or thirty degrees, westward of them. Thus, that division of the ecliptic which is called the sign Taurus lies in the constellation Aries, and the sign Gemini, in the constellation Taurus. Undoubtedly, however, when the ecliptic was thus first divided, and the divisions named, the several constellations lay in the respective divisions which bear their names.

(To be continued.)

THE FOUNDER OF GUY'S HOSPITAL.—This eccentric and noble philanthropist was a bookseller in a place then called "Stock's Market," between Cornhill and Lombard-street. He had a servant girl to whom he was so deeply attached that he agreed to marry her, and, preparatory to their nuptials, he ordered the pavement before his door to be mended as far as a *particular stone*, which he marked. The expectant wife, while her master was out, was innocently looking on at the paviors at work, and seeing they were neglecting a broken stone, drew their attention to it, when they told her that Mr. Guy had directed them not to go so far. "Well," said she, "do you mend it, and if he says anything, tell him I bade you, and I know he will not be angry." The men did so; but the poor girl had presumed too far over the directions of her lover, who, enraged, renounced the matrimonial scheme, and resolved upon endowing a hospital for the good of his country.

THE SOURCES OF HAPPINESS.—It is not by multiplying two pence by thirty that we can estimate the happiness of him who drinks claret over him who drinks beer. It is a trite saying, that the poor are as happy as the rich, and happier; but perhaps the reasons for holding this belief have not been often closely examined, and hence the general principle has been attacked as a vain sentiment, invented by the rich to appease the poor. But if we look at the main elements of human felicity, we shall find that they are among the objects of moderate attainment. They consist in health, physical and mental; in food, sufficient to satisfy hunger; in clothing, sufficient to protect the body from vicissitudes of weather; and in that enjoyment of the domestic attainments which continues the existence of our species. The wealth of the richest man that ever lived will not add to the list a fifth element of enjoyment so large as any one of these essential ingredients of happiness.

## THE MIRROR OF NATURE.

*(Continued from page 106.)*

Thus, all at once, was again opened to Duval a rich source of revenue, not a cent of which did he ever spend on himself or his clothes, but all went to gratify his thirst for knowledge. As he never went in any dress but his hermit's frock, never, even on his long day marches to the bookstores of Nancy and back, ate anything but the bread which he took with him, or the food taken by poor people, his library grew to contain four hundred volumes, and among them, since Mr. Forster had directed the selection, works of considerable intrinsic value. In wood and field, by day and partly by night, our young hermit was busy with his books and maps. How thankfully now did he esteem the privilege of having always been employed chiefly in the tending of the cows of the hermitage, just the employment the most favourable to his scientific pursuits. In the quiet of the woods, and in the grotto of the deserted quarry, there was nothing that could distract him, or divert his attention from the subject of his studies. Here he learnt to concentrate his thoughts in a way, that, for his whole subsequent life, gave him an advantage over thousands of others, so called scholars. For Duval read then, not with a divided attention, like others, whose minds are wandering in the most diverse directions among the distractions, cares, and pleasures of the world; but his whole soul, all his thinking and imagining, was fixed upon that which appeared to help him to penetrate into the domain of knowledge. The edifice of his knowledge rested not on the sand, but on the foundation of a love of rare fervour for truth, and a rational apprehension of things.

But in the midst of the still enjoyment of his present happiness, there stirred in the young solitary a desire that drew him forth into communion with men, into the world. The inward impulse which had hitherto moved him, had not yet reached its resting point. Through the food which he found in books, his wings had only grown and become strong,

He would go further and further on.

Formerly, when that impulse led him away from the sheep-fold of Clezantaine, did the wandering herd's-boy know why it was he wished to go forth and onwards? But now he knew more distinctly what the aim of his inclinations, what his true calling was. He would devote himself wholly to science.

How distant, how unattainable must such an aim have appeared to the poor lad, had he listened only to his own understanding, and not rather rested in the devout faith of his heart! The deliverance from death by starvation and cold, which he had experienced just at the right moment in the sheep-fold of the poor farmer, the happy restoration from severe illness by such strange and yet most salutary means, the childish and yet fortunate device that had led him to Lorraine, the good hand of his God, which here in a strange land had wonderfully led and blest him in all his ways, made it clear to him that his inward as well as his outward life was under a Providence that knew how best to complete every work that it has begun. This Providence had supported him in scarcity and hunger, had provided for his body, on his painful wanderings, shelter and aid; why should it not also furnish means to allay the hunger and longing wants of the mind, which it had itself formed and nourished?

Amidst these thoughts, Duval felt like one who crosses over a deep abyss upon a narrow trunk of a tree, and dares not look down into the depth, lest he should become dizzy. For ten years' service for board and clothes, he had bound himself to the hermits. At the end of this time, he would have as little money for books as he had now. His honest heart could imagine no possibility by which that written contract could be cancelled. Nevertheless, this thought caused him no care or trouble. When he meditated over the many years which must elapse before the agreement was fulfilled, they seemed to him as so many days. It did not occur to him that he would be older also. His entrance into a school or college, where he could form himself for the calling to which he felt himself destined, appeared to him as a thing that would happen of itself, and prove as easy as his journey from Champagne to Lor-



rairie, or from Clezantaine to La Rochette. His vivid imagination represented that, which was yet distant, as if it were to take place to-morrow or to-day. The hope of a youth is like a good powerful telescope, which brings the distant object so close within the sphere of vision, that it seems as if one could seize with his hand the mark, which a ball from a gun could hardly reach.

In such a happy state of mind knowing nothing of to-morrow and its sorrow, but only of to-day and its plays, a certain beautiful spring morning, in the year 1717, found him lying on the ground in the wood with his out-spread maps, studying them with the greatest attention. Suddenly, he heard a man's voice which bade him good-day. He looked up and saw a gentleman, on whose countenance a noble dignity joined with gentleness was expressed, and who asked why he was here so busy with the maps. "I am searching for and considering the way," said Duval, "from the coast of France to Quebec in Canada." "To Quebec?" asked the gentleman further. "And what have you to do with Quebec?" "I have read," replied Duval, "that there is a French seminary or High School there, where many good things are taught and where the children of poor people are received and instructed for nothing, and, therefore, I am thinking of travelling thither, to study in Quebec." "Indeed!" said the gentleman, "to learn something good, and thorough, one need not go so far; free instruction for young people, who have the will and the talent to study, may be had here too in our seminaries and high schools."

During this conversation, several other gentlemen had approached Duval, whose dress and bearing showed them to be persons of no common rank. They asked the high steward, Count von Vidampiere, for this gentleman it was who was talking with the young hermit, about the subject of the conversation and the remarkable boy with whom he talked, and then addressed several questions to Duval, which he answered with propriety and a noble openness. He dreamed not of what importance, of what consequence for his whole life, the examination would prove, to which he was then submitting; and

perhaps this ignorance was to his advantage, for thus his sound understanding, his wit and good-humour, the wonderful extent of his reading (his station in life considered), were manifested with that freedom from constraint which rendered them all the more pleasing.

The high assembly, in the midst of which an examination was held, which, for this time signified more than any doctor's examination in Paris or London, consisted chiefly of persons from the court of Lorraine. The two young princes, Leopold Clement and Francis, together with their high officers, Count von Vidampiere and Baron von Pfutschner, represented the examiners, who proposed questions to their candidate in a boor's frock, and received from him answers by which a young school-educated pupil could hardly have gained greater honour than Duval, the nursling of Nature; for in the simplicity of his whole manner it shone forth that he uttered nothing that he did not truly feel and honestly believe.

Baron von Pfutschner, the tutor of the two princes, asked Duval whether he would like to continue his studies in the school at Pont a Mousson. Duval inquired whether in that establishment, which resembled a monastic institution, liberty would be granted to go out into the woods and fields, for he could not always remain indoors. They satisfied him on this point, and at parting the baron promised to visit him again shortly.

On returning home, the princes told their father, the mild, humane Duke Leopold, what strange game they had met with in their hunt, in the acquaintance they had made with a young cow-herd who had astonished them all by his knowledge of geography and history. It required but a few words to win the good duke to the plan, of which the baron had spoken. His Grace consented that Duval should enter the institution of Pont a Mousson at his expense, and be maintained there so long as was necessary. At the duke's expense also, he was to be clothed and liberally provided with whatever might be required for his residence there and for the advantages of his education.

Duval was now twenty-two years of age. Now, in May, 1717, it was almost eight

years, since, as a poor boy, he had come to Lorraine in wooden shoes and dressed in coarse sackcloth; four years had passed since he entered the service of the hermits of St. Anna as a cow-herd.

With the thought of quitting St. Anna, now so dear to him, and its friendly inmates, he felt for the first time in all its strength what he had here enjoyed and received. He had communicated to the brethren the strange adventure he had met with in the wood. They congratulated him, but also, in their simple undisguised way, gave him to perceive their regret at their probably near separation, a regret awakened by their truly hearty love for their young friend. Here brother Antony was not behind the rest. The love was without hypocrisy, with which he silently and with a tear in his eye pressed Duval's hand, and urged upon him as a gift, the only scientific treasure which he possessed, the pocket compass. In such violent natures as brother Antony's, the Creator, together with the repulsive characteristic which not unfrequently breaks forth in them, implants in like measure an opposite and attractive capacity of love; so that oftentimes, when a warming sunbeam from above falls into the darkness of their hearts, their hatred grows into fervent love. This excitable power resembles in its working the wine which, in good hours strengthens the soul to noble deeds, while in evil hours it hurries it to its fall: but at all times it brings with it its dangers.

The school-rooms, in which we usually receive instruction, are at one time too cold, at another too hot; the dampness of their gray white walls seems as if it would symbolise that anxious perspiration which we suffer in those confining spaces. When we would listen to the instructing words of the teacher, our next neighbour on the school-bench is pulling or pushing us, another is coughing, a third whispers in our ear or speaks two or three words to us on a bit of paper; outside is spring or lovely autumn weather, and we sit and perspire there within four walls. With a more than usually awakened sympathy we then learn, how formerly Plato, and Aristotle, and Theophrastus inspired their hearers with their eloquence in the open air, in the shade

of porches and of trees. In after years one thinks, perhaps with pleasure, of well-spent school-hours, and blesses with grateful love the memory of beloved teachers, but cares not to dwell on the recollection of the black or white benches, on the dingy stoves and walls of the old school-rooms. They had not the fragrance of the woods or of the green fields which the Lord has blessed.

Quite otherwise was it with Duval. The sublime stillness of nights, only rarely broken by the sounds with which the owl and the bittern accompany their labours, the silence of the woods, and the refreshing air of their shades, must needs have had another charm for memory than our buildings with stoves and chimneys. The voice of instruction which we receive through the outward ear, had been to Duval an inward voice, and on that account, penetrating the more deeply into his soul. With such tears as we shed, when we embark on the broad ocean and bid farewell to the shores of our fatherland, Duval looked once more on his seat in the high oak, so like a stork's nest, where the rolling stars of the night awoke in his breast the aspiration for an infinite and eternal world, surrounding us everywhere. With similar emotions he took leave of the grotto in the old quarry and of every old oak or beach, in whose shade he had been at school to the invisible and yet present teachers of ancient and modern times.

Baron von Pfutschner had not forgotten his promise. Only a few days elapsed since his acquaintance with Duval, when he came, according to the custom of the time, in a coach and six, and took the young hermit with him to the Residence. He had passed his examination with success. Now he was to be promoted in the presence of the duke and a number of ladies and gentlemen of the court assembled out of curiosity. Here also our Duval bore himself with honour. Here were no such dangers or pains to be feared as in battles with wild cats or with biting foxes and weasels. He spoke and answered with child-like openness, and his remarks gave at least as much cause for admiration as for amusement. They found the peasant youth beyond all expectation intelligent, and, in his way, amiable. Some



ladies, who after the promotion, on which the gracious assurances of the duke had placed the crown, fell into conversation with Duval, admired his white teeth. "It is only an advantage," said the honest lad, "which I have in common with all dogs."

Duval, the history of whose youth is adapted above that of all others, to disclose to us the inborn instinct of the human mind in its whole force and activity, had now arrived at a resting point, beyond which his career becomes less remarkable and unusual. Like a river, which has its source in a rocky, mountainous region, and at the beginning of its course delights the eye with many a picturesque waterfall, but which only when it descends into the plains, where its flow becomes quiet and scarcely perceptible, spreads abroad its blessings through fields and meadows—this remarkable man became noteworthy, on his entrance into the world, more for his influence on the fortunes of others, than for the changes of his own. The kind Duke Leopold took him into his special favour, advanced him a year's income during the two years spent at Pont à Mousson, and afforded him opportunity to visit Paris and the Netherlands. And to such a lover of books as Duval was, what office could have been better adapted and more agreeable than that of librarian, to which, upon his return to Luneville, he was appointed by the duke. He was at the same time appointed teacher of History and Antiquities in the high-school at Luneville. This institution was at that time the resort of many foreigners, particularly of the sons of rich English families. Duval's instructions were, from their vividness and originality, so attractive, the whole manner of the man inspired such love and confidence, that he exercised a very great influence on the young. Among the young Englishmen, who, not only took the deepest interest in his public instructions, but also delighted in his society, was one, of whom Duval prophesied that he would act the no inconsiderable part which he afterwards took in the affairs of his own country. This was the statesman, afterwards so celebrated, the English minister Lord Chatham.

For the supply of his own wants, our former hermit needed very little. In the

place of all other pleasure, the delight of an occasional visit to the quiet and lonely woods and fields, ever remained the dearest to him. The country was more beautiful to him than all the splendours of Paris. He could never bring himself to give up the retirement and independence of a single life. His scholars and the poor were his children. A faithful friend, of similar tastes and fortunes, gladdened with his society his hours of study. This friend was Mr. Varinge, whom the noble Duke Leopold had taken from the workshop, in which he was found with a Euclid in his hand, and gave him opportunity to qualify himself as a teacher of mathematics in Luneville.

One portion of the considerable property which Duval possessed through the liberality of his prince and his wealthy pupils, he devoted to acts of pure gratitude for those early favours, the living remembrance of which never forsook him. Especially did he remember his beloved St. Anna. Instead of the decaying wooden dwelling of the hermits, he caused a respectable stone building with a chapel to be erected at his own expense, and at the same time purchased a considerable tract of land, which, divided into pastures and orchards, afforded abundant support to the brotherhood. To the new arrangements, which according to his plan were made at St. Anna, belonged a nursery of trees. In regard to this he directed that the hermits should devote themselves to the culture of the trees not merely for themselves, but also for their neighbours. They were required to furnish young trees gratis from their nursery to the inhabitants of the country round to the distance of three leagues from St. Anna; and if it was wished, to set out the same for nothing. They were not even to accept anything to eat, unless the distance was too great for them to go home to dinner. A capital of thirty thousand francs was in this way bestowed upon St. Anna, which long afterwards, particularly by the cultivation of trees, yielded a large income.

Two miles westward from Nancy, at St. Joseph of Messina's, there still lived in a hermitage, built by the before-mentioned brother Michael, the aged recluse who had formerly taught Duval the art of writing. His hut was so ruinous, that it threatened

to go to decay before the frame of the old man that bowed with the weight of ninety years. Duval, out of gratitude, caused a house to be built for this aged man and his successors, which, by its respectable exterior and its inward conveniences, stood in as striking contrast with the beautiful country as the decayed hut. His birth-place also, Artenay, and his yet surviving relatives, received rich tokens of his generosity. Instead of the poor dwelling of his parents, which had passed into strange hands, he built a spacious building whose stone walls and tiled roof contrasted strongly with the thatched clay hovels of the barren landscape. This building he presented to the town, to be used as a school-house and a residence for the teacher. A little village not far from Artenay, stood in need of a fountain to the great distress of the inhabitants. Duval caused a well to be dug: and if the poor tenant, who had taken him into his sheep-fold in the winter of 1709, as well as the good pastor of the place, had still been alive, the gratitude of their former nursling would certainly have been manifested towards them.

Duval had, in his first wandering into a strange land, given himself up to an instinctive impulse which was to him, as he thought, into the country nearer to the sun, upon which the winter could inflict no suffering so severe as that which visited his own poor fatherland in 1709. To the east and the south, so had he been told, these regions, favoured by nature, might be found, and his former course from west to east had confirmed his previous opinion, and moreover had had happy consequences for his whole life. The force, however, which led him, in his forty-second year, from his beloved Lorraine, at the beginning of his course, towards the south, but afterwards to the east, to a residence as pleasant as Luneville had proved to be, was different from the first impulse, which resembled the natural instinct of a hungry animal. The father-in-law of the French King Louis XV., King Stanislaus of Poland, was to be indemnified for his lost throne; the influence of France and the powers in alliance with her, compelled the reigning house of Lorraine to an exchange, which, in many respects, was no disadvantageous one. The Duke of Lor-

raine was required to give up his throne (which was in fact continually threatened by the unquiet and dangerous neighbourhood of France), for the government of the rich and beautiful Tuscany. Sorrowful as was the separation on both sides, of the duke from his subjects, and of his subjects from the duke, the forced exchange took place in 1737. Duval's paternal friend, Duke Leopold, had died; his successor, Duke Francis, set out for Florence, and Duval and his friend Varinge allowing no foreign offers to prevent them from remaining faithful to the ducal house, to which they owed all their success, departed with the duke for Italy. Duval held the same office at Florence that he held at Luneville. When a few years after, the duke married the heiress of the house of Austria and went to Vienna; and when shortly afterwards Duval's most intimate friend, the mathematician Varinge died, beautiful Florence lost all its charms for Duval. He gladly obeyed the summons of the duke, who had attained to the imperial dignity, and became the founder and first superintendent of the imperial collection of coins at Vienna. Solitary and unpretending, Duval lived and laboured at the Imperial Court. His investigations in the whole circle of knowledge grew ever more earnest. His mind was emancipated from all the prejudices which could obstruct his progress. All his energies, his whole property, was at the service of his neighbour. He lived to a serene old age of eighty-one years, retained full command of his faculties to the last, and departed upon his journey into the world beyond the grave as cheerfully and with even better hopes, than when he set out in his boyhood from impoverished Champagne for the beautiful, peaceful Lorraine.

#### THE GETTING RICH WITHOUT TROUBLE.

How must the good Duval have laboured merely to obtain that, which every city child learns at school—how many sleepless nights did it cost him, before he could understand what and where the constellations are, and what the degrees on the equator of a globe mean! Worthy persons of the same stamp with Duval, who earn the treasure of their knowledge with difficulty and have to dig it out of the depths, may be likened to those



well-to-do-people, who, leaving home poor, accumulate property by their own diligence and frugality, while we, to whom everything comes at school that can gratify our desire of knowledge, resemble those who have never earned their wealth but inherited it from rich parents.

How much harder than to Duval and his friend, Varinge, is the supply of the thirst for knowing, implanted deeply in the soul, in case of those who lack, perhaps from birth, that sense which furnishes us the most information respecting the world of knowledge, the sense of sight. But this difficulty is unquestionably greatest in the case of those individuals, so much to be pitied, who like Laura Bridgman, are wanting, not only in the sense of sight, but also in hearing, smell, and taste. Duval, when, like the builders of the Tower of Babel, he sought to penetrate into the starry heavens by building his stork's-nest on the high oak, saw indeed those shining worlds with his eyes, and every ray of the same caused him to feel something of their power in himself; but when the poor Laura read, with her finely-feeling fingers, in one of the books printed for the blind, something about the stars, how would she be compelled to task all her powers to the uttermost to form an idea of the nature of things which she had never seen! And yet, in such cases, her efforts were never wholly without result and reward. The essential nature of what is capable of being known, the mind of man may apprehend, without having any knowledge of it, obtained through the senses; the impulse towards knowledge in the mind is ultimately directed to something which is of the nature of the mind; the aim of its endeavour is a certain confirmation of that, which it hopes for and inwardly apprehends, even without seeing it with the external eye.

The blind mute, James Mitchell, had a great advantage over Laura in this respect, that he not only possessed very acute senses of smell and taste, but that a faint glimmer of daylight still penetrated his organs of vision. What curiosity, and what delight in knowledge was oftentimes expressed in all his looks and gestures, when he changed his position for one, in which a ray of the sun fell

directly upon that point in his eye, not entirely closed against the light, and when, by means of a piece of looking-glass he could catch the reflection of a sun's ray on that point, or could bring a burning light into the neighbourhood of his eye. A devoted friend of astronomy can have no greater pleasure, when the telescope opens to him an entrance into the mysterious depths of the starry heavens, than James felt, when for him likewise, a faint ray broke into his perpetual night, from the world of perceptible things that was shut against him. The more entirely cut off and lonely the situation of the mind is, in relation to the external visible world, the more eagerly does it seize at every thing which comes within the range of its recognition. The companions of the celebrated Parry, on his voyage to the polar regions, gazed at the water-fowl flying over them with the curiosity with which we, perhaps, look at a rare animal from Africa, because upon the great floating ice-islands, over which they drew their sledge-boat, there was no other living thing to be seen. A man, who is placed alone upon a desert island, looks curiously at every little wave of the sea that rises above the rest, because in every such appearance, he fancies a ship that shall bring him tidings from the world of other beings.

(To be continued.)

AN INTELLIGENT DONKEY.—At Croxdale North Farm, in the occupation of Mr. Joseph Nicholson, flourishes one of the most sensible and utilitarian of donkeys of which we ever remember to have read since the days of Balaam. So soon as the shades of evening set in, he begins to collect his companions, a dozen or so of calves, and proceeds to drive them home. When they have arrived in the calf-yard, he allows them to drink at the well: after which he takes a drink himself, and then marches on with his charge before him; and if any gluttonous calf stops short to eat grass, Sir John's virtuous indignation is excited, and he runs open-mouthed at him, or any straggler, until he contrives at last to drive them into the fold-yard in safety—a duty which he holds to be “stuff o' the conscience.”—*Durham Chronicle.*

## FAMILIAR CONVERSATIONS ON INTERESTING SUBJECTS.

"CLARA! Clara!" called Mrs. Wilson at the door of her daughter's room one bright sunshiny morning in the latter part of Spring, "Clara! come, it is time you were up."

Hearing no answer, she gently opened the door, and perceived that the little girl had already arisen, and left her room. As the weather had been unusually fine for several days past, she concluded that she had taken a stroll in the fields, as she usually did in pleasant weather. Breakfast being over, and Clara still absent, her mother began to feel a little uneasy about her, and had just determined to go out and look for her, when the door opened, and the little runaway, with a face glowing with excitement, entered.

"Why, where in the world have you been, Clara?" asked her mother, as she took a handkerchief from her pocket, and wiped the perspiration from her brow.

"Why mother, it was such a lovely morning, I thought I would take a little walk before breakfast; I did not intend however to go as far, nor to stay as long as I have done; but before I was aware of it, I had reached the brook, and would you believe it, mother, the opposite bank was covered with flowers."

"You did not venture to cross, Clara, I hope?"

"Oh! no, mother; I have not forgotten my last attempt at that."

(In trying to cross one day, during the previous summer, Clara had fallen in; and but for the timely aid of a farmer's lad, who was providentially at hand, most likely would have been drowned. Since then her mother had forbidden her ever to attempt it again.)

"How did you get your flowers, then?"

"I was just going to tell you, mother: while I was standing looking at them, Farmer Holt's man came along, and offered to get some for me. It took him longer than I thought it would; and so for fear you would be uneasy, I ran every step of the way home."

"That you should not have done, Clara: you know how apt you are to have the headache, after exercise of that kind; but get your breakfast, and then bring

your flowers into the sitting-room, and we will examine them together."

Fifteen, perhaps twenty minutes had passed after Clara had finished her meal, before her mother was quite ready to attend to her. This time was spent by her in arranging and examining her flowers.

"They are most of them violets," she remarked as her mother, having finished her work, sat down beside her.

"You can tell what class they belong to, I suppose Clara?"

"They have all got five stamens, mother, so they must belong to the fifth class; that is the class Pent-Andria."

"You have got a few primroses and cowslips, too, I see Clara, both of which belong to this class."

"Oh! mother do you recollect those two verses you taught me about the primrose? I was trying to think of them as I came home; but I could only recollect the first line, 'Mark, in yonder thorny vale!'"

"I don't know whether I can repeat them or not Clara, but I'll try:"

"Mark in yonder thorny vale,  
Fearless of the falling snows,  
Careless of the chilly gale,  
Passing sweet the primrose grows.  
Milder gales and warmer beams  
May the gaudier flow'rets rear,  
But to me the primrose seems  
Proudest gem that decks the year."

"I wish you would write them down, mother, if you please, for me, when you have time; I should like to learn them. But now I have found out the class of my flowers, how am I to know the order, genus, &c?"

"One thing at a time, Clara; do you think you can designate the different classes?" (See page 111).

"Pretty well, I think, mother; I wrote them down as you told me, and have gone over them several times since, and I find, too, that knowing the meaning of the words from which they are derived, assists me a great deal in distinguishing them. I was puzzled at first to know what the class mon-adelphia was; but as soon as I brought to mind the meaning of adelphia I could tell directly."

"You recollect there was one class we did not speak of?"

"Yes, ma'am, the 21st."



"This class is named from two Greek words: *Crypto* and *Gamia*, which signifies a concealed union. The stamens and pistils of plants of this class are so small, that they cannot be seen without a microscope. Now, for the orders: those of the first twelve classes are founded upon the number of pistils they contain: one pistil, the first order; 2 pistils, the second order, and so on."

"Then, mother, all these flowers belong to the fifth class, and the first order?"

"Yes, that is the class *Pent-Andria*, order *Mono-Gynia*."

"You have not told me how the orders were named, mother."

"True; I had forgotten that: they are named by prefixing Greek numerals to *Gynia*, which you know signifies pistil, thus—"

"Stop, mother, let me see if I can't name them."

<i>Mono-Gynia</i> ...	1 pistil.	<i>Hepta-Gynia</i> ...	7 pistils.
<i>Di-Gynia</i> .....	2 ..	<i>Octo-Gynia</i> ...	8 ..
<i>Tri-Gynia</i> .....	3 ..	<i>Ennea-Gynia</i> ...	9 ..
<i>Tetra-Gynia</i> ...	4 ..	<i>Deca-Gynia</i> ...	10 ..
<i>Penta-Gynia</i> ...	5 ..	<i>Endeca</i> .....	11 ..
<i>Hexa-Gynia</i> ...	6 ..		

"No *Deca-Gynia*, ten pistils, and all over that *Poly-Gynia*. The best way to learn to distinguish the different orders of plants is by analyzing them; but as the season is not yet far enough advanced, to afford us subjects for analyzation, I will endeavour to teach you their names and the circumstances on which they are founded."

"Have all the classes an equal number of orders, mother?"

"No: some have only two; others have ten. Class 1st, *Mon-Andria*, contains only two orders."

"*Mono-Gynia* and *Di-Gynia*."

"Yes: we have very few examples of plants of this class in the United States. The *Hippurus*, or as it is commonly called *mare's tail*, belongs to the first order. It is an aquatic plant, and though destitute of both calyx and corolla, is considered a perfect flower."

"What do you mean by an aquatic plant, mother?"

"One that grows in water."

"But why is it called perfect when it has neither calyx or corolla?"

"All plants possessing stamens and

pistils, though destitute of other organs, are styled perfect in botany. In addition to the one I have named, there is a plant called *Salicornia*, also belonging to this order, which is found on the North American sea-coast, and on the coast of the Mediterranean. This plant is burned, and its ashes used in the manufacture of soda. The arrow-root, a valuable tropical production, which you know is considered very nutritious for the sick, is also found in this order."

"What made them give it such a funny name, mother?"

"The Indians gave it this name, in consequence of its having been used by them to extract the poison from wounds made by their poisoned arrows. Another well-known root found here, is the ginger: which was first known to the Arabians, and by them called *Zinziber*. The only plant which I shall name of the second order *Di-Gynia* of this class is *Blitum*, an American plant; it has one stamen and two pistils; calyx but no corolla."

"How I wish we could procure specimens of all the different classes and orders, mother."

"It would be much more interesting if we could, and you would be able to understand the subject a great deal better I have no doubt: but this is impossible."

INQUIETUDE OF THE MIND.—It is believed that most persons pass a large portion of their lives in a state of inquietude and uneasiness. Persons who have no bodily disease are anxious and disturbed. They have some urgent want which cannot be gratified, or which cannot be so without incurring some evil, which would be worse than the unsatisfied want. They have the dread of some probable or possible evil to come, and which is the more terrible, because of the uncertainty of the manner and of the time in which it may come. Others are uneasy from remembering the past, in which some benefit was not secured, some blunder made, some wrong done to themselves, some vain gratification not obtained. Such persons are always groaning, sighing and grumbling. These are frightful instances of the inquietude and uneasiness of the human mind—companions which every man, more or less, has in his bosom.

## THE "ROMANCE" OF SEA-LIFE.

SOME of our pupils have no doubt, at one period of their existence, entertained pleasant notions of a life at sea; far be it from us to divert emulations from the adoption of perhaps a very honourable career to some, but we would in plain language divest the subject of the charming fiction with which the imagination may have invested it.

We personally know something of the sea, of sailors, and of their life, both ashore and afloat, both in the forecabin and the cabin, both abroad and at home. We know also that there is a marvellously prevalent notion among landmen, that a sailor's life is the most romantic of all lives, and that he is himself a very romantic personage individually. We know that the mere name of "sea," "ship," or "sailor," excites emotion in the breasts of novel-reading lads, and adventurous youths in general. There seems to be an inherent witchery in the very idea of the "glad waters of the dark-blue sea;" but this has been stimulated a thousand-fold by the popular songs of Dibdin and others, portraying sailors in such colours that they cannot recognize themselves,\* and also by certain modern fictions, which however admirable as works of art, convey anything but a correct notion of the real workday life of the gallant but plain honest fellows who man England's wooden walls. In the books in question, everything which can throw a charm over the sea—everything which tends to impress the reader with a vague idea that sailors are a separate race of mortals, with most fascinating characteristics—is skilfully dwelt upon; but the stern, homely, matter-of-fact, monotonous life they lead, is carefully left in the background, or alluded to in a very slight and deceptive manner. Can we wonder, therefore, that boys of ardent imaginations are absorbingly

attracted by such an idealized profession? So enthralling is the love of the sea thus generated, that a good authority declares that he has known youths who could not hear the creaking of a block used in hoisting sugar to the upper-floor of a grocer's warehouse, without their imaginations being fired with vivid dreams of ships and the ocean! Once let a stripling become impressed with a longing for the sea, no matter how generated, and the very means you adopt to check his diseased fancy will only strengthen and confirm it. Yet his case is precisely analogous to that of a youth falling passionately in love with a maiden whom he has never seen!

We can give a case in point, in which we were personally concerned. About eight years ago, we ourselves were guilty of writing a sea-novel, a copy of which fell into the hands of a boy, a first-cousin of ours. He told us that he had read it over and over, till he knew it by heart, and nothing would serve his turn but he must go to sea. His parents were distressed, and we had a long interview with him, and did our utmost to disabuse his mind of the romantic notions which our own book alone had created. All in vain! He would believe his own wild impression from our fiction, rather than our sober, truthful *viva-voce* advice. He went a short first voyage, on liking, and on his return frankly told us that had he known what a hard, harsh life a sailor's really was, he would never have quitted land.

"But," said he, "I should be laughed at if I give it up now! I am a sailor for life, and all through that book of yours!"

He was then regularly apprenticed to a merchantman, but the mate treated him so cruelly that he deserted to a man-o'-war; and, if living, he is probably yet in the navy.

The two great classes of boys who go to sea, are those who have imbibed romantic notions concerning it, and long to realize them; and those who are sent by their friends as a means to reform them of bad habits. Of the two, the latter class generally make the best sailors; the others are too much disgusted at the reality, too heart-broken, at the utter annihilation of all their fine dreams, to take kindly and well to their rough calling. There are, of course, numerous ex-

\* We may, perhaps, except a few of Dibdin's best songs; but the actual fact is, that the songs which are really sung on ship-board are as different from Dibdin's as it is possible to conceive. The songs which sailors love to sing are doggrel, without a spark of imagination. It has been said that Dibdin's songs recruited the navy in war-time more than a dozen press-gangs. Yes, but the songs did not cause *sailors* to ship, but only landmen.



ceptions in both classes ; and of the former, many cling to the sea, and learn to become good sailors out of sheer desperation and stubborn resolve to make the best of a bad bargain, rather than acknowledge themselves to be woefully deceived.

Let us not be misunderstood. We ourselves enthusiastically loved the sea when young, and we love it yet, but in a very different degree. It is a noble profession, that of the wild waves' mastery, but it is emphatically one of the hardest, worst paid, and *most prosaic* ! Yes, young readers of Captain Maryat and of Fennimore Cooper, we say it is downright prosaic !—and we know what it is to lay out on a yard in a hurricane. We say, moreover, that sailors themselves are, with very few exceptions, the most prosaic and matter-of-fact among mortals. You may sneer at this ; but one week, one day, nay, even one hour, of actual sea-service, would perhaps convince you that we are speaking advisedly. Let truth be spoken above all things. A sailor's life brings him in occasional contact with sublime manifestations of the Divine power ; but he little regards them. His duties absorb all his attention, and there is no time for sight-seeing and reflection, nor is sentiment of any kind allowed to be indulged in on shipboard. On the other hand, he will for weeks and months lead the dullest and most unexciting life conceivable. Day after day the same monotonous round of common-place duties are exacted with iron discipline. It is all very pleasant to you, young gentleman, to sit with your feet on a parlour fender, and gloat over picturesque and highly-wrought descriptions of nautical manœuvres ; but we can tell you, that not one of these is felt to be anything but ordinary work by those who actually perform them. There is nothing very delightful in the hourly act of running up and down ladders like a bricklayer's labourer, and hauling rough ropes till your back feels ready to break and your heart to burst ; there is nothing peculiarly elevating and chivalrous in the act of picking oakum, and making spun-yarn and sinnet—and sailors are steadily kept at these and similar labours in the intervals between shifting sails ; nor is there any inexpressible charm in the act of scraping and oiling masts and yards, and washing decks and tarring rigging.

## HOW TO TEACH COMPOSITION.

As soon as a child can spell and understand a few simple words, you should begin to exercise them in little sentences, and should continue the practice their whole school life.

Suppose you write the names of the colours, black, blue, &c., and then let each child, in turn mention all the things they can think of which are black, blue, green, &c. They will say, "The grass is green ; the trees are green ; my frock is green ; my lips are red ; ink is black ; the sky is blue ; my shoes are black," &c. ; and in a quarter of an hour you will have written a long spelling lesson. Another day you may write down all that is sweet, sour, bitter ; all they can think of that is hard, soft, rough, smooth, round, square, heavy, light ; and so you may go on, day after day. Sometimes let them dictate a text from Scripture which they wish to tell you of, or a verse of a psalm or hymn, or a proverb ; but every day let some little matter be written on the board.

It is a good exercise sometimes to ask children to recollect all the objects they observed in the woods, fields, or lanes, as they walked to or from school, and let them bring the leaves of different trees, the wild flowers, &c., and then let them tell you how to spell the words.

Now, some people may tell you that it is of no use to teach these children these common, easy things, and that all you should do is to give them what they call book learning ; but I assure you, that if you do not allow them to write from their own heads little sentences about easy matters they can think and tell about, they will never know how to express themselves properly or clearly ; and if they can tell you in writing what they now know, and think, and understand about, when they have read and learned more, they will be able to write down their thoughts and recollections on other and more difficult subjects.

Sometimes you may ask the children to write down on their slates all the things which they know to be right to do, and all that they know to be wrong.

Write on your slates, or on the walls the *names* of all fruits which grow on trees ; the *names* of fruits which grow on bushes ;

*what* plants are cultivated for the roots? *what* for the leaves? *what* for the seeds? The seeds of what plants grow in pods like beans? *what* seeds grow at the top of plants like wheat? *What* trees are useful for timber? *What* trees are cultivated for the fruit they bear? *What* for both timber and fruit?

Mention all the creatures you can think of that feed on grass. Ask *what* is the colour of grass? *What* is hay? When is the grass cut down? with what instrument is it cut down? Do you think the cattle would like to lie down on the hard road as well as on the soft grass? Would you like to look at the fields if they were brown or red, as well as you do now that they are green?

Then say, "Now write on your slates all you can think about grass; now, all you know about the different sorts of corn; all you know about garden vegetables, and the manner of cultivating them. What difference can you mention between birds and beasts? What difference between birds and fishes?"

The names of a great variety of substances, whether manufactured or unmanufactured, may gradually be arranged, and the colours, shapes, and uses, added.

THE SCHOOLMASTER.—After all, we suspect that, in a great school, it is not so much the system as the master himself that gives the general tone and character to the studies of the place. It is the command which he obtains, the confidence which he inspires, the manner and the language in which he incites, encourages, admonishes—the interest which he appears to take in the general proficiency—the relative importance which he attaches to the different branches of study—his own taste, feeling, judgment—his ardour in the pursuit of knowledge—his moral discrimination in his comments on the lessons of the school, which are reflected and multiplied in the answering mirrors of the young minds around him. In him resides the power of converting the dry and irksome task into an exercise of the imagination, of the memory, and of the reason, cheerfully and emulatively, instead of being heavily and reluctantly performed.

## DRAWING AND WRITING.

THE HON. HORACE MANN, late Superintendent of Massachusetts Schools, says, in a report of a visit to the schools of Europe:

"Such excellent handwriting as I saw in the Prussian schools I never saw before. I can hardly express myself too strongly on this point. In Great Britain, France, or in our own country, I have never seen schools worthy to be compared with theirs in this respect. This superiority can not be attributed in any degree to a better mode of holding the pen; for I never saw so great a proportion of cases in any schools where the pen is so awkwardly held.

"This excellence must be referred, in a great degree, to the universal practice of learning to draw contemporaneously with learning to write.

"I believe a child will learn both to draw and write with more ease than he will learn writing alone. In the course of my tour I passed from countries where almost every pupil in every school could draw with ease, and most of them with no inconsiderable degree of beauty and expression, to those where drawing was not practised at all; and I came to the conclusion that, with no other guides but the copy-books of the pupils, I could tell whether drawing was taught in schools or not."

ILLEGIBILITY.—The following anecdote will illustrate the misfortune of illegible writing, and hint at the importance of giving more attention to this subject.

An English gentleman once applied to the East India Company to procure an office for a friend of his in India. Having succeeded in obtaining the appointment, his friend wrote him a letter of thanks, alluding to his intention of sending him an equivalent. The Englishman could make nothing of the word *equivalent* but *elephant*, and being pleased with the idea of receiving such a noble animal as a present from his friend, he was at the expense of erecting a large and expensive building for its accommodation. In a few weeks the equivalent came, which proved to be not quite so large as an elephant, for it was nothing more nor less than a pot of *sweetmeats*.



EASTERN RAMBLES AND  
REMINISCENCES.

## RAMBLE THE TWENTY-FOURTH.

HOTEL D'ORIENT, CAIRO; ITS INMATES  
AND OUTMATES—A QUEER CHARACTER  
—CAIRO—A CONFUSION OF TONGUES—  
—THE TOMBS OF THE CALIPHS AND  
MAMELUKES—THE PETRIFIED FOREST—  
HELIOPOLIS, THE "ON" OF SCRIPTURE  
—A BEDOUIN ENCAMPMENT—ARAB HOS-  
PITALITY—THE DESERT—SHAVING THE  
HEAD—THE BEDAWI; THEIR APPEAR-  
ANCE, HABITS, SKILL IN TRACKING  
FOOTSTEPS, THEIR DESCENT AND RELI-  
GION—THE PALACE AND GARDENS OF  
SHOUBRA—FAREWELL TO EGYPT.

"O blest retirement! friend to life's decline,  
Retreats from care that never must be mine.  
How blest is he who crowns, in shades like  
these,  
A youth of labour with an age of ease!  
Who quits a world where strong temptations  
try,  
And since 'tis hard to combat, learns to fly!"  
GOLDSMITH.

"To you, ye wastes, whose artless charms  
Ne'er drew ambitious eye,  
'Scaped a tumultuous world's alarms,—  
To your retreats I fly."—BEATTIE.

The Hôtel D'Orient, kept by Colombi and Co.; a place with plenty of bustle, a confusion of tongues like a modern Babel, a host of donkeys outside with black drivers, and a host of donkeys inside driving blacks. An abundant odour of savoury viands, plenty of fleas, musquitos, servants, fowls, pestering porters, and overland people. Some patent-perpetually-squalling babies in black nurses arms; some going to, and some coming from, India; over-anxious delicate mammas that cannot bear the heat going out, and ditto the cold coming back; jaundiced-looking uncles and papas, who have been to India, and are always growling either because they cannot endure anything like Indian things, or else because nothing is like it is in England; wheezing old bachelors with plenty of money and impatience; young aristocratic T. G's who are always calling "Waiter!" and smoking cigars from the first thing in the morning to the last at night, during which time they imbibe a curious mixture

composed of Café Royal, claret,\* Bass' pale ale, brandy and water, champagne, orgent, and, as the crochet ladies say, repeated from \* again. If it were not for this, they say that it would be impossible to keep up the steam—perhaps they mean the smoke.

A queer place is this Hôtel D'Orient. Yes, or any other hotel in Cairo, especially when the Overland Mail has arrived at Alexandria a day or two before.

The coffee-room is always in a bustle, some going in and others going out; and to crown the whole, if you observe well, you will see a dear little old fat man, dressed in English costume, with the exception of a rather spicy fez or red cloth Turkish cap, which covers his cranium. His post is generally on the sofa. On the right hand side, just as you go in, watching each person with the keenness of a hawk, or else you may observe him in button-hole confidence imparting his knowledge to a stranger, generally a rapid man or one *verde*, at the window. Mirabile dictu! he is an astonishing man! and his stories! Oh! Abdallah, the brave, the devourer! you could not swallow his stories, they are indigestible—too tough even for sailors; and we poor wretches can digest almost any yarn, however tough, but none unless a *verde* or an ostrich could digest his. Albeit his appetite is good, and his conscience, like his stomach, elastic; moreover he sleeps little, and cares little who sleeps, for he sings loudly, smokes much, talks incessantly—unless engaged in eating; and although devoid of wit, yet nevertheless contrives to keep some one always in a roar of laughter, so that there are sure to be two awake, one laughing and another grumbling. Reader, beware of him with the fez, and small piggish eyes. You can never hope to "sew him up," either with cigars or liquids; and as to solids, he will require more cramming than a turkey, for like the boa constrictor, he sleeps between his meals, which are generally twice a month; viz., when the Overland passengers arrive. Mind, he does not give you a benefit of feasting, sitting up all night and drinking at your expense, and then, like a leech, when it is well gorged, drop off.

Cairo is not quite so slow a place as





ARABS EATING, WITH THE AUTHOR IN THE CENTRE.

some "overlands" assert, it is not quite so "stunning" as others of the same party remark. It has some good hotels, a tolerable library, to which strangers are admitted, a literary society called "The Egyptian Literary Association," and an excellent museum of curiosities belonging to Dr. Abbott.

It is unnecessary to enter into the history of Cairo; it is a long affair if we commence with the foundation of the first city by the Arabs in Egypt, and trace it to that of Cairo, or as it is more correctly called El-Káhireh, which is now called Masr, and continue to notice its advances and retrogression in prosperity.

It is familiarly known, by name at least, to most of us by means of those interesting tales, "The Arabian Nights;" and, as you walk through its streets, you fancy this one is the veritable Haroun Alrashid in disguise, searching for adventures; that the other is Morgiana; and in fact you wander through its streets almost bewildered with the various characters you meet, and the cries that resound from all quarters.

Cairo has a variety of names like most Oriental cities, and of these its native name of El-Káhireh, or the "Victorious," and Mum-ed-Dunga, or "the Mother of the World," are the most general; and as its architecture is very fine, excellent Arabian, we must get out of this noisy hotel and donkey through its streets.

Bah! bah! Diamond! Diamond! Euta! Yallah! You rascal! Fine jackass! Moushtaib Keeter! Him go well! Along, Monsieur! Baksheesh Howadji! Now, Muster Inglis, vat you give go to Yopolis! and Be off, you rascal! were the various sounds that saluted us as we made our appearance outside the hotel-door, and a regiment of



donkeys were backed in a heap against us to the imminent danger of our tender feet. It was no use beating them, they retreated only to renew the charge,—which they did most vigorously, until finally we were routed; and being hustled on to the back of one of the animals, which the grinning one-eyed driver pronounced to be a “fine jackass,” we donkeyed complacently through the grand square and several streets, towards the tombs of the Caliphs and Mamelukes.

There are few places in Cairo more interesting than the tombs of the Caliphs and the Mamelukes, with their massive architecture, enriched by a profusion of arabesque ornamentation; their domes and graceful minarets towering above all. Near to the tombs of the Mameluke Beys is that of Mohammed 'Alee, which has no doubt received his remains since the period we visited it. It is an arabesque building, plain outside, but superbly fitted up in the interior, with Turkey carpets, cushions, and other conveniences for the use of those relatives that visit the tomb to pray over the remains of their relations. Kutchuk Pasha, the son-in-law of Mohammed 'Alee, who was notorious for his cruelty, is buried here. It is said that he was quietly disposed of by order of his father-in-law for plotting against the government.

Having satisfied our curiosity by inspecting the tombs, we proceeded southward, nearly at right angles to the road, across the desert to Suez; and after donkeying for about two hours along a low barren valley covered with gravel, sea-shells, and sand, we crossed a low range of sand hillocks, which we had observed for some time running parallel to the roadway. If we had before been astonished at some of the wonders of Egypt, we were certainly not prepared for the scene that now presented itself. All around us on the sand of the desert were fragments of trees of various sizes and shapes, converted into stone. Every time our donkeys moved, and struck their hoofs against these petrified masses, they sounded like a piece of cast iron when it is struck. This extraordinary forest extends for many miles, and the sand is so thickly strewn with masses of this petrified wood, which is of a dark brown hue, that it is

difficult to proceed with any degree of comfort on a donkey. We dismounted, and commenced collecting specimens of the silicified wood, which is so natural that many of the pieces appear as if they had only lately been felled. Here you stumble over roots, remnants of branches, portions of the trunks of trees worm-eaten, with the bark partly separated, and the holes filled with the dust caused by the insects, all petrified; and even the delicate sap-vessels and central portion of the wood distinctly visible. We bore away several blocks from one to four feet long, and from six inches to two and even three feet in diameter, and then proceeded to Heliopolis, the On of Scripture, which the donkey-drivers call Yopolis.

Heliopolis is now called Mataiyeh, and is marked by a lofty obelisk, one of the two formerly known as Pharaoh's Needles. It was here that Dionysius, the Areopagite, saw the sun obscured when “there was darkness all over the earth until the ninth hour.” The Arabs point to an old gnarled sycamore-tree, under whose shade they say the Holy Family rested during “the flight from Egypt,” and adjoining this is a well where they are said to have quenched their thirst.

Afar off we saw some of the tents of the wandering Bedamoi, which are made of a stuff manufactured from black goat's hair, and are generally from twenty to thirty feet long, and twelve or fifteen broad. As these people have generally



SHAVING THE HEAD.

been praised for their hospitality to strangers we donkeyed to the encampment, and making the usual salam, were at once conducted to the chief. He was a jolly fellow, and at once invited us to share his desert fare with the rest of his household; so down we squatted in the most approved tailor fashion, and, seizing a spoon, dived into the mess of mashed lentils and coarse bread, which was placed in a wooden bowl upon the sand. The old sheik who sat next to me, and with his back resting against the pole of the tent, plied his spoon most vigorously, and was well supported by his opposite neighbour; while the others lacking so great a luxury, dipped their fingers into the bowl and sucked them afterwards with a zeal that would have set Lord Castlereagh into fits. My gastronomic powers appeared to excite some degree of astonishment, or it might be, my European costume, for the other Bedamois, who were outside the tent, were peeping at the Frank ladling away so busily at the desert mess.

The furniture of the tents of the Bedamois consists of pack and riding saddles for camels and horses; bags, buckets, bottles, and pitchers of leather; hair bags; a wooden mortar for pounding coffee; a hand-mill, a coffee-pot, copper or brass pan, wooden bowls and dishes, with a number of ropes to fasten their animals.

As soon as we had finished the simple repast, our host led us outside his tent to see the rest of the tents, and the animals.

Some of these sons of the desert were seated before their tents smoking vigorously from long cherry-stick pipes; others were tethering the cattle, and some were employed in pounding coffee; but the most amusing scene to us was a small group a few yards from where we stood.

One of the Bedawi was stretched upon the ground leaning upon his elbows, and enjoying the luxury of having his head shaven by a companion, who plied the razor with the skill of one accustomed to perform the office of barber. The third was too busily engaged in scanning us to take any notice of his fellow marauders, and it was only when he observed the sheik that he sprang to his feet and made us a salam.

The desert has its charms for the Bedouins or Bedawi, who worship the

boundless waste of scorching sand, where not a tree or herb gladdens the eye,

"And faint and sickly winds for ever howl around."

The Bedawi are hordes of petty wandering merchants, trading with what they carry from place to place, and may be met with wherever the sands of the desert are tossed by the fierce Simoom. The personal appearance of the male Bedawi varies with the climate, tribe, occupation &c., but generally speaking they are a middle-sized and rather thin race of men, with brown complexions, and strong, crisp, black hair. Their strength is considerable, and their activity and alertness still greater. Their restless disposition prevents their becoming corpulent, and also the privations they undergo, for their powers of abstinence and endurance of fatigue are very remarkable, and scarcely exceeded by those of their own camels. The women when young are pretty, but when old are shrivelled and ugly, which is somewhat augmented by the custom they have of scarifying their faces, and rubbing the wound with gunpowder, so as to leave a dark mark afterwards. Many of them also tattoo their lips, hands, and feet, so that with these barbarous additions, and a profusion of wrinkles on a skin that is so deep and brown as almost to be mistaken for black, the painted eyebrows, nose-jewels, and bits of glass, tin and coins stuck about their hair, they look almost hideous when seen by the uncertain light of twilight, or when cowering o'er the flickering fire.

From time immemorial the Bedawi have been celebrated for their skill in tracking footsteps of animals and men. The most experienced can determine from the impression on the sand, whether the man or animal belongs to his own or some neighbouring tribe. He judges by the depth of the impression, whether the man or animal carried a load or not; by its distinctness, if the man or animal passed that day, or one or two days previously; by the regularity of the intervals between the steps whether they were fatigued or not; by the impression he describes, whether he be a stranger (Frank), on account of the shoes; by the print of the foot of an Arab being more full than that



of a European, he is enabled to settle that point. He can also tell, from the impression, the footsteps of his camels, and those of his nearest neighbours; whether the camels were pasturing, and not carrying a load, mounted by one person only or two, or heavily laden. If the marks of the two fore-feet be fainter or deeper than those of the hind ones, he judges of the Arab's health; and according to the manner in which the grass of the oases is cropped, he knows which camels have been there. In fact, the knowledge displayed by them appears almost supernatural, so great is their observation of the most trifling circumstances.

They generally encamp near some rivulet or well, when they are to be found; but frequently in the boundless desert, they encamp anywhere; however, their main object is to remain where the cattle can have pasturage. It sometimes happens, that although the pasturage is food, yet there is no water near, and then they abstain from drinking anything but milk for several weeks together. The form of their encampment varies with the number of their tents, circumstances, and the season of the year; but the general plan is to place them in straight lines, except when they are fed in numbers, when they are arranged in a circle. When they are tired of one place they move to another; but sometimes the paucity of food for the cattle, absence of water or other circumstances, influence them. They tether their cattle in a curious way;—a thick straw rope is passed along the bottom of the forelegs of the animals, so as to fasten them all together, and thus united they are placed in a row under a shed made of date leaves.

These dark - skinned Bedawi pride themselves upon their descent; for they are direct descendants of Ishmael, of whom it was foretold, three thousand years ago, that they should dwell in the presence of their enemies, and that their hand should be against every man, and every man's hand against them. Their noble bearing is such, that they generally win a stranger's affection; for if once their word is passed, nothing will make them violate it. They need no forms of law, no judge, jury, or common-councilmen,—their word is their bond; and, be it for

good or ill, a Bedouin will abide by his word. They are a most remarkable people, and did space permit, I would fain make some further observations upon them; for, in the midst of the civilized world, they have remained uncivilized, and are the only people in the world who remain unconquered, although Sesostrius, Cyrus, Pompey, Trajan, and the Turks, in the height of their power, attempted to subject them.

The sun looks down upon this time-honoured race,—these descendants of the Sabeens, whose queen Balkis, whom the Holy Scriptures call the Queen of Saba, went out to visit Solomon; they brown their tents and their skins alike. They bow; they say "*Allah-'hu Ac-bar*," "God is great:" they lock their right hands fast together and kiss each other's cheek when they meet, and murmur "*Salam Alekoon*," "Peace be to you!" to which the addressed answers, "*Alekoon Salam*!" "They barter, steal, commit murder, salam, and wander from place to place, and never change in manners, or customs. The sun rises, and sets, and darkens their skins; time rolls on, and still the Bedawi dwell in the desert, and still they never change. They profess the religion of Mahommed openly, but in truth have none. They have neither priests nor temples belonging to them. They say that the religion of Mahommed was not made for them, and if you ask, "Why?" They answer, "How can we wash, who have no water? how can we bestow alms who have no money? why should we fast at Rumadour, when we do so all the year? why should we make a pilgrimage to Mecca, if God is everywhere? can we not worship our Creator in the air? what need, then, have we of mosques? If we can pray ourselves, why should we have priests?"

Before a meal they offer a thanksgiving or grace, which is characteristic and expressive. The family deposit their long knives in a circle on the ground, and the sheik, or head of the family, taking a piece of bread in his hand raises it towards heaven: then puts it to his lips, and exclaims aloud "*Allah*," God!

Away, away from the desert wide to the crowded streets of the city; a kind farewell to our Bedouin friends, and adieu to the desert for ever.

We are once more in the town, and donkeying grandly and tranquilly to the summer palace of Mahommed 'Alee at Shoubra, which is about an hour's ride from the city. How we rambled along the broad and shaded road to the delightful gardens, of that most wonderful man. Time and space forbid the mention of all we saw at Shoubra, which was rigidly laid out in the formal Italian geometric style, with paths all angles, and trees all quaint shapes; we could relate all about the bath, the aviary, the smoking-room, and a host of other rooms, with the carving, and gilding, &c.; but want of space forbids us. No, we must rush from Shoubra to our hotel, and after paying our bill donkey it down to Boolak, and get on board our boat as soon as possible.

Oh, thou fertilizing beauteous Nile,—  
the soul of Egypt!

“A hundred times the morn  
Hath tinged thy living flood; which now rolls  
back,  
Leaving rich verdure upon fields forlorn,  
Flowers on its track,  
Green health and plenty on the parched land,  
And fruit—on what was sand.”

Onward, onward sweeps the glittering waters, and bears us from all the mysterious and wonderful buildings on thy banks, to that once proud city Alexandria. Mystery, beauty, and art, we bid thee farewell! Egypt farewell! aye farewell, and for ever!

“We turn and gaze, and turn again,  
Oh! death were mercy to the pain,  
Of them that bid farewell!”

**PRETENSION.**—Many persons obtain a reputation and influence by mere pretension. They pretend to know everything and everybody. By obtaining a smattering, of all most every subject, an impression of thorough knowledge is easily given, especially if good conversational powers can be brought into use. But this outer covering can be easily seen through by men of real knowledge and genius. It is but little pleasure they enjoy after all; for while, by assuming an air of superiority, they feel the pleasure of power, they must feel, at the same time, the meanness of the deception, and the contempt which men of real character feel towards them.

## DRAWING IN SCHOOLS

WHOEVER is acquainted with the great mass of our schools, especially in the country, must be aware that one of their greatest evils is a want of sufficient business for all the children, especially the youngest. Children must be employed, and if the teacher fail to furnish them with something useful and pleasing to do, they will themselves find employment, though it bring upon them the teacher's rebuke, or even the rod.

The youngest children of the school, especially those who are unable to read, are commonly called up in a class, or separately, once or twice each half day, and spend from five to fifteen minutes at each exercise; and during the remainder of the school-hours, which amounts to a large proportion of the whole time they are in school during each day, they have little or nothing to do but to obey the frequent commands “Sit still,” “Sit up straight,” “Fold up your hands.” Not unfrequently all books are kept from them, “because they destroy them, and do not learn anything from them.

Now, a dozen small children thus unemployed must inevitably cause disorder. It is contrary to their natures for them to remain idle. The blood courses rapidly through their veins, their spirits are active and restless, and they are not capable of deriving pleasure from continued study. Hence comes the inquiry, What shall be done with such children? How can we furnish them employment which will not only please them, but from which they may be constantly deriving some good?

Give them slates and pencils, with convenient desks to lay them on, and even if left entirely to themselves it will be far better than if without them. But place before them cards with well-formed letters, words, the elementary geometrical figures, drawings of familiar objects, as of tools, farming and household utensils, animals, &c., and they will teach themselves something of drawing, and more of letters, spelling, reading and writing. Besides while thus engaged, they are kept from play and those mischievous tricks so common among small children at school,



which are sources of great annoyance to both teachers and older pupils.

If, in addition to this, the teacher would occasionally give the pupils familiar directions in the elements of drawing, by practical and simple lessons on the black-board, and show them also how the Roman letters are formed, and how to begin a drawing of an object—which lines to make first, which next, and so on, step by step—much, very much time would be saved both teachers and pupils, besides the important benefits derived by the children, as they almost spontaneously learn something important in several branches.

In this way should drawing exercise be introduced into every school where there are young children, and as they advance sufficiently let them be furnished with paper and pencils, and allowed to copy, by the use of these, their lessons from the cards. In this manner three-fourths of the early years of schooling, which now are wasted in many schools, may be turned to profit.

This plan is not a mere speculation; it has been tested in several instances, and found to succeed admirably. Our own experience has convinced us of its utility. In a school of eighty pupils, of ages from five to twenty-five, we found the plan to be all that it is here recommended, and the best government for young children is to keep them furnished with pleasing and profitable employment. Of course the ingenuity of the teacher will at times be taxed for changes, as children tire of too long attention to one thing, but a multitude of changes can be produced even with the use of the slate and pencil. M.

ORIGIN OF THE PENDULUM.—Galileo, when under twenty years of age, was standing one day in the metropolitan Church of Pisa, when he observed a lamp which was suspended from the ceiling, and which had been disturbed by accident, swinging backwards and forwards. This was a thing so common, that thousands, no doubt, had observed it before; but Galileo, struck by the regularity with which it moved backwards and forwards, reflected upon it, and perfected the method now in use, of measuring time by means of a pendulum.

## FRAMING WORDS INTO SENTENCES.

I was in the habit of dictating, or giving out to my pupils, each having a slate, a set of words, which they were required to write down. I always dictated very slowly, that all might have ample time. When the dictation was completed, they were required to exercise their ingenuity in so putting them into sentences of their own construction that they would make sense, as parts of those sentences.

Suppose the words dictated, or given out, were *apples, corn, moon, hat, gold, red*; and suppose the pupils were required to incorporate them into sentences, the following might be the result of the effects of some very young pupils:

"*Apples* are good to eat. A new *hat*. *Corn* grows. *Gold* is yellow. The bright *moon*. A piece of *red* cloth."

Others would probably say much more. Perhaps their lists would read thus:

"I am very fond of *apples*. I love to look at the *moon*. My father raises *corn*. Some *hats* are made of wool. Money is made of *gold*, and silver, and copper. There is a bird called a *red* bird."

Sometimes I have given them a much longer list than this, and required them to select a certain number of the words, such as they chose, and "frame in." I have sometimes given out twenty or thirty words, and required them to select seven of those which appeared to them the most interesting.

In other instances, I have requested all those who preferred to do so, to select some favourite word, and relate, on their slates, a story about it, spending their whole time on that single word and the story. I have in this way occasionally drawn out quite a long story from a boy who at first thought he could do nothing.

I recollect, in particular, having given out, on a certain occasion, the word *bee* among the rest. One of my boys, scarcely more than ten years of age, immediately wrote a long account of an adventure in a meadow, with a nest of humble-bees.

Another mode of this exercise, still more interesting to some of my older pupils, consisted in framing as many of the words of the list as they could put

into a single sentence or verse I have sometimes found half a dozen, or even more words crowded into two or three lines across the slate.

This exercise, in its varied forms and diversities, was one of the best I ever introduced into my school. It both interested my pupils, and was a source of much instruction.

J. R. C.

### MULTIPLICITY OF STUDIES IN SCHOOL.

BECAUSE improvements have been made in teaching, and because youth now acquire a greater amount of knowledge at a specified age than was formerly attained, even at a much more advanced period of life, many of the community seem to entertain expectations altogether extravagant. It is needless to say that these expectations are seldom realized; and whenever they are realized, it is often at the expense of the health and even the life of the youthful prodigy. Numerous instances have occurred within the observation of the writer, to verify this assertion. School managers, parents, and teachers seem to overlook the great law of nature, that all healthy growth, whether in the physical, moral, or intellectual world, must be gradual, and in accordance with pre-established laws. The strength of the oak must be the result of many years; the enlarged humanity of Howard was the fruit of extensive observation, careful reflection, and oft-repeated self-denial; and the great genius of Newton or Laplace would never have been developed without long-continued exertion and profound attention.

That the growth of the youthful intellect be vigorous and healthy the energies must be exerted on few things at a time, and those few must be studied faithfully, and, at least, somewhat extensively.

An array of studies is prepared, sufficient to occupy one's life-time; sometimes a single one of them would fill up threescore years and ten; and the tyro is expected to master the whole in a year or two. Such a splendid prospectus promises a rich and varied harvest; but it most generally proves to be a crop from a sand-bank. Indeed, these liberal promises ought to be regarded as *primâ facie* evidence of inefficiency, as presumptive proof

that the amount really learned will be in the inverse ratio to the number of studies.

Let us look into the school-room, and see the operation of this multifarious system. The writer once visited an academy in which thirty recitations per day were heard by a single teacher; and they were just such recitations as might be expected—absolutely nothing. The pupils were merely asked if they found any difficulties; and it may be inferred that they found very few, for it was asking the blind to distinguish colours, or the deaf to detect a discord in music. Under such a system, the learner is hurried from one thing to another; no time is left for reflection, no opportunity for research and investigation; truth and error are strangely confounded; what is attained is learned by rote; and, what is most to be deplored, the youth imagines that he has sounded the whole depth of a subject, when his eye has merely floated over its surface. Hence, conceit, (the offspring of ignorance, the bane of all progress), is early implanted in the mind, and can be eradicated only by severe disappointment and mortification. The effect upon the teacher also is bad, especially if the same person has many branches to teach. He can neither devote the necessary time to self-preparation, nor expend sufficient labour in drilling, to develop the abilities of his pupils. A smattering of the text-book is all that the pupil acquires, and the teacher's view is necessarily quite limited.

Now we do not object to learning many things, but we repudiate the idea that all can be profitably pursued at the same time, or that any considerable degree of acquaintance with all can be acquired in an inconsiderable space of time. Let so few studies be pursued at once that the student may become interested in each, that he may study each understandingly, and so thoroughly as to strengthen his powers, and give him such knowledge as will be of real and lasting service to him.

Careful and thorough study generates strength; the novelty and freshness of a subject gives zest; curiosity is awakened and gratified; but since the powers of digestion and assimilation are vigorous and active, the appetite is renewed, and the result is, not only healthy, but rapid growth of the intellectual man.

M.



# POPULAR ASTRONOMY.

## LETTER XI.

### THE MOON.

"Soon as the evening shades pervail  
The Moon takes up the wondrous tale,  
And nightly to the listening earth  
Repeats the story of her birth."—*Addison*.

HAVING now learned so much of astronomy as relates to the earth and the sun, and the mutual relations which exist between them, you are prepared to enter with advantage upon the survey of the other bodies that compose the solar system. This being done, we shall then have still before us the boundless range of the fixed stars.

The moon, which next claims our notice, has been studied by astronomers with greater attention than any other of the heavenly bodies, since her comparative nearness to the earth brings her peculiarly within the range of our telescopes, and her periodical changes and very irregular motions, afford curious subjects, both for observation and speculation. The mild light of the moon also invites our gaze, while her varying aspects serve barbarous tribes, especially, for a kind of dial-plate inscribed on the face of the sky, for weeks, and months, and times, and seasons.

The moon is distant from the earth about two hundred and forty thousand miles; or, more exactly, two hundred and thirty-eight thousand five hundred and forty-five miles. Her angular or apparent diameter is about half a degree, and her real diameter, two thousand one hundred and sixty miles. She is a companion, or satellite, to the

earth, revolving around it every month, and accompanying us in our annual revolution around the sun. Although her nearness to us makes her appear as a large and conspicuous object in the heavens, yet in comparison with most of the other celestial bodies, she is in fact very small, being only one forty-ninth part as large as the earth, and only about one seventy millionth part as large as the sun.

The moon shines by light borrowed from the sun, being itself an opaque body, like the earth. When the disc, or any portion of it, is illuminated, we can plainly discern, even with the naked eye, varieties of light and shade, indicating inequalities of surface which we imagine to be land and water. I believe it is the common impression,



Fig. 35.

that the darker portions are land and the lighter portions water; but if either part is water, it must be the darker regions. A smooth polished surface, like water, would

reflect the sun's light like a mirror. It would, like a convex mirror, form a diminished image of the sun, but would not itself appear luminous like an uneven surface, which multiplies the light by numerous reflections within itself. Thus, from this cause, high broken mountainous districts appear more luminous than extensive plains.

By the aid of the telescope, we may see undoubted indications of mountains and valleys. Indeed, with a good glass, we can discover the most decisive evidence that the surface of the moon is exceedingly varied,—one part ascending in lofty peaks, another clustering in huge mountain groups, or long ranges, and another bearing all the marks of deep caverns or valleys. You will not, indeed, at the first sight of the moon through a telescope, recognise all these different objects. If you look at the moon when half her disc is enlightened (which is the best time for seeing her varieties of surface), you will, at the first glance, observe a motley appearance, particularly along the line called the *terminator*, which separates the enlightened from the unenlightened part of the disc. (Fig. 35.) On one side of the terminator, within the dark part of the disc, you will see illuminated points, and short, crooked lines, like rude characters marked with chalk on a black ground. On the other side of the terminator you will see a succession of little circular groups, appearing like numerous bubbles of oil on the surface of water. The further you carry your eye from the terminator, on the same side of it the more indistinctly formed these bubbles appear, until towards the edge of the moon they assume quite a different aspect.

Some persons, when they look into a telescope for the first time, having heard that mountains and valleys are to be seen, and discovering nothing but these unmeaning figures, break off in disappointment, and have their faith in these things rather diminished than increased. I would advise you, therefore, before you take even your first view of the moon through a telescope, to form as clear an idea as you can, how mountains, and valleys, and caverns, situated at such a distance from the eye, ought to look, and by what marks they may be recognised. Seize, if possible, the most favourable period (about the time of the first quarter), and previously learn from drawings and explanations, how to interpret everything you see.

What, then, ought to be the respective appearances of mountains, valleys, and deep craters, or caverns, in the moon? The sun shines on the moon in the same way as it shines on the earth; and let us reflect, then, upon the manner in which it strikes similar objects here. One half the globe is constantly enlightened; and, by the revolution of the earth on its axis, the terminator, or the line which separates the enlightened from the unenlightened part of the earth, travels along from east to west, over different places, as we see the moon's terminator travel over her disc from new to full moon; although, in the case of the earth, the motion is more rapid, and depends on a different cause. In the morning, the sun's light first strikes upon the tops of the mountains, and, if they are very high, they may be brightly illuminated while it is yet night in the valleys below. By degrees, as the sun rises, the circle of illumination travels down the mountain, until at length it reaches the bottom of the valleys; and these in turn enjoy the full light of day. Again; a mountain casts a shadow opposite to the sun, which is very long when the sun first rises, and shortens continually as the sun ascends, its length at a given time, however, being proportioned to the height of the mountain; so that, if the shadow be still very long when the sun is far above the horizon, we infer that the mountain is very lofty. We may, moreover, form some judgment of the shape of a mountain, by observing that of its shadow.

Now, the moon is so distant that we could not easily distinguish places simply by their elevations, since they would be projected into the same imaginary plane which constitutes the apparent disc of the moon; but the foregoing considerations would enable us to infer their existence. Thus, when you view the moon at any time within her first quarter, but better near the end of that period, you will observe, on the side of the terminator within the dark part of the disc, the tops of mountains, which the light of the sun is just striking, as the morning sun strikes the tops of mountains on the earth. These you will recognise by those white specks and little



crooked lines, before mentioned, as is represented in Fig. 35. These bright points and lines you will see altering their figure, every hour, as they come more and more into the sun's light; and, meanwhile, other bright points, very minute at first, will start into view, which also in turn grow larger as the terminator approaches them, until they fall into the enlightened part of the disc. As they fall further and further within this part, you will have additional proofs that they are mountains, from the shadows which they cast on the plain, always in a direction opposite to the sun. The mountain itself may entirely disappear, or become confounded with the other enlightened portions of the surface; but its position and its shape may still be recognized by the dark line which it projects on the plane. This line will correspond in shape to that of the mountain, presenting at one time a long serpentine stripe of black, denoting that the mountain is a continued range; at another time exhibiting a conical figure tapering to a point, or a series of such sharp points; or a serrated, uneven termination, indicating, in each case respectively, a conical mountain, or a group of peaks, or a range with lofty cliffs. All these appearances will indeed be seen in miniature; but a little familiarity with them will enable you to give them, in imagination, their proper dimensions, as you give to the pictures of known animals their due sizes, although drawn on a scale far below that of real life.

In the next place, let us see how valleys and deep craters in the moon might be expected to appear. We could not expect to see depressions any more than elevations, since both would alike be projected on the same imaginary disc. But we may recognise such depressions, from the manner in which the light of the sun shines into them. When we hold a china teacup at some distance from a candle in the night, the candle being elevated but little above the level of the top of the cup, a luminous crescent will be formed on the side of the cup opposite to the candle, while the side next to the candle will be covered by a deep shadow. As we gradually elevate the candle, the crescent enlarges and travels down the side of the cup, until finally the whole interior becomes illuminated. We observe similar appearances in the moon, which we recognise as deep depressions. They are those circular spots near the terminator before spoken of, which look like bubbles of oil floating on water. They are nothing else than circular craters or deep valleys. When they are so situated that the light of the sun is just beginning to shine into them, you may see, as in the teacup, a luminous crescent around the side furthest from the sun, while a deep black shadow is cast on the side next to the sun. As the cavity is turned more and more towards the light, the crescent enlarges, until at length the whole interior is illuminated. If the tea-cup be placed on a table, and a candle be held at some distance from it, nearly on a level with the top, but a little above it, the cup itself will cast a shadow on the table like any other elevated object. In like manner, many of these circular spots on the moon cast deep shadows behind them indicating that the tops of the craters are elevated far above the general level of the moon. The regularity of some of these circular spots is very remarkable. The circle in some instances, appears as well formed as could be described by a pair of compasses, while in the centre there not unfrequently is seen a conical mountain casting its pointed shadow on the bottom of the crater. I hope you will enjoy repeated opportunities to view the moon through a telescope. Allow me to recommend to you, not to rest satisfied with a hasty or even with a single view, but to verify the preceding remarks by repeated and careful inspection of the lunar disc, at different ages of the moon.

The various places on the moon's disc have received appropriate names. The dusky regions being formerly supposed to be seas, were named accordingly; and other remarkable places have each two names, one derived from some well-known spot on the earth, and the other from some distinguished personage. Thus, the same bright spot on the surface of the moon is called *Mount Sinai* or *Tycho*, and another, *Mount Etna* or *Copernicus*. The names of individuals, however, are more used than the others. The diagram, Fig. 36, (see page 154,) represents rudely, the telescopic appearance of the full moon. The reality is far more beautiful. A few of the most



remarkable points have the following names corresponding to the numbers and letters on the map:—

- |  |   |                |
|--|---|----------------|
| 1. Tycho,                                | 5. Helieon,   | 8. Archimedes, |
| 2. Kepler,                               | 6. Eratosthenes,                                      | 9. Eudoxus,    |
| 3. Copernicus,                           | 7. Plato,   | 10. Aristotle. |
| 4. Aristarchus,                          |   |                |
| A. Mare Humorum, <i>Sea of Humours</i> , | E. Mare Tranquillitatis, <i>Sea of Tranquillity</i> , |                |
| B. Mare Nubium, <i>Sea of Clouds</i> ,   | F. Mare Serenitatis, <i>Sea of Serenity</i> ,         |                |
| C. Mare Imbrium, <i>Sea of Rains</i> ,   | G. Mare Fecunditatis, <i>Sea of Plenty</i> ,          |                |
| D. Mare Nectaris, <i>Sea of Nectar</i> , | H. Mare Crisium, <i>Crisian Sea</i> .                 |                |

The heights of the lunar mountains, and the depths of the valleys, can be estimated



Fig. 36.

with a considerable degree of accuracy. Some of the mountains are as high as five miles, and the valleys in some instances, are four miles deep. Hence, it is inferred, that the surface of the moon is more broken and irregular than that of the earth, its mountains being higher and its valleys deeper, in proportion to its magnitude, than those of the earth.

The varieties of surface in the moon, as seen by the aid of large telescopes, have been well described by Dr. Dick, in his "Celestial Scenery," and I cannot give you a better idea of them, than to add a few extracts from his work:—"The lunar mountains in general exhibit an arrangement and an aspect very different from the mountain scenery of our

globe. They may be arranged under the four following varieties:

"First, *insulated mountains*, which rise from plains nearly level, shaped like a sugar loaf, which may be supposed to present an appearance somewhat similar to Mount Etna, or the Peak of Teneriffe. The shadows of these mountains, in certain phases of the moon, are as distinctly perceived as the shadow of an upright staff, when placed opposite to the sun; and these heights can be calculated from the length of their shadows. Some of these mountains being elevated in the midst of extensive plains, would present to a spectator on their summits magnificent views of the surrounding regions.

"Secondly, *mountain ranges*, extending in length two or three hundred miles. These ranges bear a distant resemblance to our Alps, Apennines, and Andes; but they are much less in extent. Some of them appear very rugged and precipitous: and the highest ranges are in some places more than four miles in perpendicular altitude. In some instances, they are nearly in a straight line from northeast to southwest, as in the range called the *Apennines*; in other cases, they assume the form of a semicircle, or crescent.

"Thirdly, *circular ranges*, which appear on almost every part of the moon's surface, particularly in its southern regions. This is one grand peculiarity of the lunar ranges, to



which we have nothing similar on the earth. A plain, and sometimes a large cavity, is surrounded with a circular ridge of mountains, which encompasses it like a mighty rampart. These annular ridges and plains are of all dimensions, from a mile to forty or fifty miles in diameter, and are to be seen in great numbers over every region of the moon's surface; they are most conspicuous, however, near the upper and lower limbs, about the time of the half moon.

"The mountains which form these circular ridges are of different elevations, from one fifth of a mile to three miles and a half, and their shadows cover one half of the plain at the base. These plains are sometimes on a level with the general surface of the moon, and in other cases they are sunk a mile or more below the level of the ground which surrounds the exterior circle of the mountains.

"Fourthly, *central mountains*, or those which are placed in the middle of circular plains. In many of the plains and cavities surrounded by circular ranges of mountains there stands a single insulated mountain, which rises from the centre of the plain, and whose shadow sometimes extends, in the form of a pyramid, half across the plain to the opposite ridges. These central mountains are generally from half a mile to a mile and a half in perpendicular altitude. In some instances, they have two, and sometimes three, different tops, whose shadows can be easily distinguished from each other. Sometimes they are situated towards one side of the plain, or cavity; but in the great majority of instances their position is nearly or exactly central. The lengths of their bases vary from five to about fifteen or sixteen miles.

"The *lunar caverns* form a very peculiar and prominent feature of the moon's surface, and are to be seen throughout almost every region, but are most numerous in the south-west part of the moon. Nearly a hundred of them, great and small, may be distinguished in that quarter. They are all nearly of a circular shape, and appear like a very shallow egg-cup. The smaller cavities appear, within, almost like a hollow cone, with the sides tapering towards the centre; but the larger ones have, for the most part, flat bottoms, from the centre of which there frequently rises a small, steep, conical hill, which gives them a resemblance to the circular ridges and central mountains before described. In some instances, their margins are level with the general surface of the moon; but in most cases, they are encircled with a high annular ridge of mountains, marked with lofty peaks. Some of the larger of these cavities contain smaller cavities of the same kind and form, particularly in their sides. The mountainous ridges which surround these cavities reflect the greatest quantity of light; and hence that region of the moon in which they abound appears brighter than any other. From their lying in every possible direction, they appear, at and near the time of full moon, like a number of brilliant streaks, or radiations. These radiations appear to converge towards a large brilliant spot, surrounded by a faint shade, near the lower part of the moon, which is named Tycho,—a spot easily distinguished even by a small telescope. The spots named Kepler and Copernicus are each composed of a central spot with luminous radiations."\*

The broken surface and apparent geological structure of the moon has suggested the opinion, that the moon has been subject to powerful *volcanic* action. This opinion receives support from certain actual appearances of volcanic fires, which have at different times been observed. In a total eclipse of the sun, the moon comes directly between us and that luminary, and presents her dark side towards us under circumstances very favourable for observation. At such times, several astronomers, at different periods, have noticed bright spots, which they took to be volcanoes. It must evidently require a large fire to be visible at all, at such a distance; and even a burning spark, or point but just visible in a large telescope, might be in fact a volcano raging like Etna or Vesuvius. Still, as fires might be supposed to exist in the moon from different causes, we should require some marks peculiar to volcanic fires, to assure us that such was their origin in a given case. Dr. Herschel examined this point with great attention, and with better means of observation than any of his predecessors enjoyed, and

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\* Dick's "Celestial Scenery," Chapter IV.

fully embraced the opinion that what he saw were volcanoes. In April, 1787, he records his observations as follows: "I perceive three volcanoes in different places in the dark part of the moon. Two of them are already nearly extinct, or otherwise in a state of going to break out; the third shows an eruption of fire or luminous matter." On the next night, he says: "The volcano burns with greater violence than last night; its diameter cannot be less than three seconds; and hence the shining or burning matter must be above three miles in diameter. The appearance resembles a small piece of burning charcoal, when it is covered with a very thin coat of white ashes; and it has a degree of brightness about as strong as that with which such a coal would be seen to glow in faint daylight." That these were really volcanic fires, he considered further evident from the fact, that where a fire, supposed to have been volcanic had been burning, there was seen, after its extinction, an accumulation of matter, such as would arise from the production of a great quantity of lava, sufficient to form a mountain.

It is probable that the moon has an *atmosphere*, although it is difficult to obtain perfectly satisfactory evidence of its existence; for granting the existence of an atmosphere bearing the same proportion to that planet as our atmosphere bears to the earth, its dimensions and its density would be so small that we could detect its presence only by the most refined observations. As our twilight is owing to the agency of our atmosphere, so, could we discern any appearance of twilight in the moon, we should regard that fact as indicating that she is surrounded by an atmosphere. Or, when the moon covers the sun in a solar eclipse, could we see around her circumference a faint luminous ring, indicating that the sunlight shone through an aerial medium, we might likewise infer the existence of such a medium. Such a faint ring of light has sometimes, as is supposed, been observed. Schroeter, a German astronomer, distinguished for the acuteness of his vision and his powers of observation in general, was very confident of having obtained, from different sources, clear evidence of a lunar atmosphere. He concluded, that the inferior or more dense part of the moon's atmosphere is not more than fifteen hundred feet high, and that the entire height, at least to the limit where it would be too rare to produce any of the phenomena which are relied on as proofs of its existence, is not more than a mile.

It has been a question, much agitated among astronomers, whether there is *water* in the moon. Analogy strongly inclines us to reply in the affirmative. But the analogy between the earth and the moon, as derived from all the particulars in which we can compare the two bodies, is too feeble to warrant such a conclusion, and we must have recourse to other evidence, before we can decide the point. In the first place, then, there is no positive evidence in favour of the existence of water in the moon. Those extensive level regions, before spoken of, and denominated seas in the geography of this planet, have no other signs of being water, except that they are level and dark. But both these particulars would characterize an earthly plain, like the deserts of Arabia and Africa. In the second place, were those dark regions composed of water, the terminator would be entirely smooth where it passed over these oceans or seas. It is indeed indented by few inequalities, compared with those which it exhibits where it passes over the mountainous regions; but still, the inequalities are too considerable to permit the conclusion that these level spots are such perfect levels as water would form. They do not appear to be more perfect levels than many plain countries on the globe. The deep caverns, moreover, seen in those dusky spots which were supposed to be seas, are unfavourable to the supposition that those regions are covered by water. In the third place, the face of the moon, when illuminated by the sun and not obscured by the state of our own atmosphere, is always serene, and therefore free from clouds. Clouds are objects of great extent; they frequently intercept light, like solid bodies; and did they exist about the moon, we should certainly see them, and should lose sight of certain parts of the lunar disc which they covered. But neither position is true; we neither see any clouds about the moon, with our best telescopes, nor do we, by the intervention of clouds, ever lose sight of any portion of the moon when our own atmosphere is clear. But the want of clouds in the lunar atmosphere almost necessarily implies the absence of water in the moon. This planet is at the same distance from the



sun as our own, and has, in this respect, an equal opportunity to feel the influence of his rays. Its days are also twenty-seven times as long as ours, a circumstance which would augment the solar heat. When the pressure of the atmosphere is diminished on the surface of water, its tendency to pass into the state of vapour is increased. Were the whole pressure of the atmosphere removed from the surface of a lake, in a summer's day, when the temperature was no higher than seventy-two degrees, the water would begin to boil. Now it is well ascertained, that if there be any atmosphere about the moon, it is much lighter than ours, and presses on the surface of that body with a proportionally small force. This circumstance, therefore, would conspire with the other causes mentioned, to convert all the water of the moon into vapour, if we could suppose it to have existed at any given time.

But those, who are anxious to furnish the moon and other planets with all the accommodations which they find in our own, have a subterfuge in readiness, to which they invariably resort in all cases like the foregoing. "There may be," say they, "some means, unknown to us, provided for retaining water on the surface of the moon, and for preventing its being wasted by evaporation: perhaps it remains unaltered in quantity, imparting to the lunar regions perpetual verdure and fertility." To this I reply, that the bare possibility of a thing is but slight evidence of its reality; nor is such a condition possible, except by miracle. If they grant that the laws of Nature are the same in the moon as in the earth, then, according to the foregoing reasoning, there cannot be water in the moon; but if they say that the laws of Nature are not the same there as here, then we cannot reason at all respecting them. One who resorts to a subterfuge of this kind ruins his own cause. He argues the existence of water in the moon, from the analogy of that planet to this. But if the laws of Nature are not the same there as here, what becomes of his analogy? A liquid substance which would not evaporate by such a degree of solar heat as falls on the moon, which would not evaporate the faster, in consequence of the diminished atmospheric pressure which prevails there, could not be water, for it would not have the properties of water,—and things are known by their properties. Whenever we desert the cardinal principle of the Newtonian philosophy,—that the laws of Nature are uniform throughout all her realms,—we wander in a labyrinth; all analogies are made void; all physical reasonings cease; and imaginary possibilities or direct miracles take the place of legitimate natural causes.

On the supposition that the moon is inhabited, the question has often been raised, whether we may hope that our telescopes will ever be so much improved, and our other means of observation so much augmented, that we shall be able to discover either the lunar inhabitants or any of their works.

The improbability of our ever identifying *artificial structures* in the moon may be inferred from the fact, that a space a mile in diameter is the least space that could be distinctly seen. Extensive works of art, as large cities, or the clearing up of large tracts of country for settlement or tillage, might indeed afford some varieties of surface; but they would be merely varieties of light and shade, and the individual objects that occasioned them would probably never be recognised by their distinctive characters. Thus, a building equal to the great pyramid of Egypt, which covers a space less than the fifth of a mile in diameter, would not be distinguished by its figure; indeed, it would be a mere point. Still less is it probable that we shall ever discover any inhabitants in the moon. Were we to view the moon with a telescope that magnifies ten thousand times, it would bring the moon apparently ten thousand times nearer, and present it to the eye like a body twenty-four miles off. But even this is a distance too great for us to see the works of man with distinctness. Moreover, from the nature of the telescope itself, we can never hope to apply a magnifying power so high as that here supposed. As I explained to you, when speaking of the telescope, whenever we increase the magnifying power of this instrument we diminish its field of view, so that with very high magnifiers we can see nothing but a point, such as a fixed star. We at the same time also, magnify the vapours and smoke of the atmosphere, and all the imperfections of the medium, which greatly obscures the

object, and prevents our seeing it distinctly. Hence it is generally most satisfactory to view the moon with low powers, which afford a large field of view and give a clear light. With Clark's telescope, belonging to Yale College, (America,) we seldom gain anything by applying to the moon a higher power than one hundred and eighty, although the instrument admits of magnifiers as high as four hundred and fifty.

Some writers, however, suppose that possibly we may trace indications of lunar inhabitants in their works, and that they may in like manner recognise the existence of the inhabitants of our planet. An author, who has reflected much on subjects of this kind, reasons as follows: "A navigator who approaches within a certain distance of a small island, although he perceives no human being upon it, can judge with certainty that it is inhabited, if he perceives human habitations, villages, corn-fields, or other traces of cultivation. In like manner, if we could perceive changes or operations in the moon, which could be traced to the agency of intelligent beings, we should then obtain satisfactory evidence that such beings exist on that planet; and it is thought possible that such operations may be traced. A telescope which magnifies twelve hundred times will enable us to perceive, as a visible point on the surface of the moon, an object whose diameter is only about three hundred feet. Such an object is not larger than many of our public edifices; and therefore were any such edifices rearing in the moon, or were a town or city extending its boundaries, or were operations of this description carrying on, in a district where no such edifices had previously been erected, such objects and operations might probably be detected by a minute inspection. Were a multitude of living creatures moving from place to place, in a body, or were they even encamping in an extensive plain, like a large army, or like a tribe of Arabs in the desert, and afterwards removing, it is possible such changes might be traced by the difference of shade or colour, which such movements would produce. In order to detect such minute objects and operations, it would be requisite that the surface of the moon should be distributed among at least a hundred astronomers, each having a spot or two allotted to him, as the object of his more particular investigation, and that the observations be continued for a period of at least thirty or forty years, during which time certain changes would probably be perceived, arising either from physical causes, or from the operations of living agents." \*

## LETTER XII.

### THE MOON.—PHASES.—HARVEST MOON.—LIBRATIONS.

"First to the neighbouring Moon this mighty key  
Of Nature he applied. Behold! it turn'd  
The secret wards, it open'd wide the course  
And various aspects of the queen of night:  
Whether she wanes into a scanty orb,  
Or, waxing broad, with her pale shadowy light  
In a soft deluge overflows the sky."—*Thomson's Elegy.*

LET us now inquire into the revolutions of the moon around the earth, and the various changes she undergoes every month, called her *phases*, which depend on the different positions she assumes, with respect to the earth and the sun, in the course of her revolution.

The moon revolves about the earth from west to east. Her apparent orbit, as traced out on the face of the sky, is a great circle; but this fact would not certainly prove that the orbit is really a circle, since, if it were an ellipse, or even a more irregular curve, the projection of it on the face of the sky would be a circle, as explained to you before. (See page 127.) The moon is comparatively so near to the earth, that her apparent movements are very rapid, so that, by attentively watching her progress in a clear night, we may see her move from star to star, changing her place perceptibly, every few hours. The interval during which she goes through the entire circuit

\* Dick's "Celestial Scenery."



of the heavens, from any star until she comes round to the same star again, is called a *sidereal month*, and consists of about twenty-seven and one-fourth days. The time which intervenes between one new moon and another is called a *synodical month*, and consists of nearly twenty-nine and a half days. A new moon occurs when the sun and moon meet in the same part of the heavens; but the sun as well as the moon is apparently travelling eastward, and nearly at the rate of one degree a day, and consequently during the twenty-seven days while the moon has been going round the earth, the sun has been going forward about the same number of degrees in the same direction. Hence, when the moon comes round to the part of the heavens where she passed the sun last, she does not find him there, but must go on more than two days, before she comes up with him again.

The moon does not pursue precisely the same track around the earth as the sun does, in his apparent annual motion, though she never deviates far from that track. The inclination of her orbit to the ecliptic is only about five degrees, and of course the moon is never seen further from the ecliptic than about that distance, and she is commonly much nearer to the ecliptic than five degrees. We may therefore see nearly what is the situation of the ecliptic in our evening sky at any particular time of year, just by watching the path which the moon pursues, from night to night, from new to full moon.

The two points where the moon's orbit crosses the ecliptic are called her *nodes*. They are the intersections of the lunar and solar orbits, as the equinoxes are the intersections of the equinoctial and ecliptic, and, like the latter, are one hundred and eighty degrees apart.

The changes of the moon, commonly called her *phases*, arise from different portions of her illuminated side being turned towards the earth, at different times. When the moon is first seen after the setting sun, her form is that of a bright crescent, on the side of the disc next to the sun, while the other portions of the disc shine with a feeble light, reflected to the moon from the earth. Every night, we observe the moon to be further and further eastward of the sun, until, when she has reached an elongation from the sun of ninety degrees, half her visible disc is enlightened, and she is said to be in her *first quarter*. The terminator, or line which separates the illuminated from the dark part of the moon, is convex towards the sun from the new to the first quarter, and the moon is said to be *horned*. The extremities of the crescent are called *cusps*. At the first quarter, the terminator becomes a straight line, coinciding with the diameter of the disc; but after passing this point, the terminator becomes concave towards the sun, bounding that side of the moon by an elliptical curve, when the

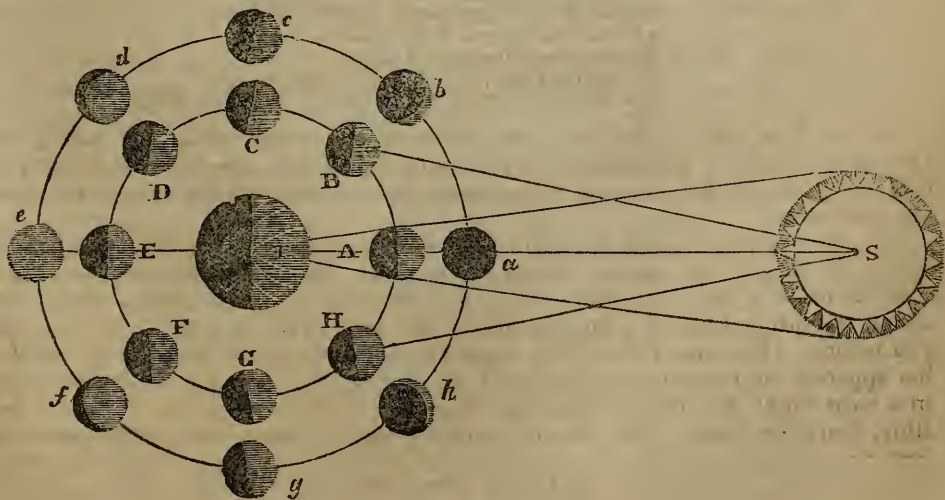


Fig. 37.

moon is said to be *gibbous*. When the moon arrives at the distance of one hundred and eighty degrees from the sun, the entire circle is illuminated, and the moon is *full*. She is then in *opposition* to the sun, rising about the time the sun sets. For a week after the full, the moon appears gibbous again, until, having arrived within ninety degrees of the sun, she resumes the same form as at the first quarter, being then at her *third quarter*. From this time until new moon, she exhibits again the form of a crescent before the rising sun, until, approaching her *conjunction* with the sun, her narrow thread of light is lost in the solar blaze; and finally, at the moment of passing the sun, the dark side is wholly turned towards us, and for some time we lose sight of the moon.

By inspecting figure 37, (where T represents the earth, A, B, C, &c., the moon in her orbit, and *a, b, c, &c.*, her phases, as seen in the heavens,) we shall easily see how all these changes occur.

You have doubtless observed, that the moon appears much further in the south at one time than at another, when of the same age. This is owing to the fact that the ecliptic, and of course the moon's path, which is always very near it, is differently situated with respect to the *horizon*, at a given time of night, at different seasons of the year. This you will see at once, by turning to an artificial globe, and observing how the ecliptic stands with respect to the horizon, at different periods of the revolution. Thus, if we place the two equinoctial points in the eastern and western horizon, *Libra* being in the west, it will represent the position of the ecliptic at sunset in the month of September, when the sun is crossing the equator; and at that season of the year, the moon's path through our evening sky, one evening after another, from new to full, will be nearly along the same route, crossing the meridian nearly at right angles. But if we place the winter solstice, or first degree of *Capricorn*, in the western horizon, and the first degree of *Cancer* in the eastern, then the position of the ecliptic will be very oblique to the meridian, the winter solstice being very far in the south-west, and the summer solstice very far in the north-east; and the course of the moon from new to full will be nearly along this track. Keeping these things in mind, we may easily see why the moon runs sometimes high and sometimes low. Recollect, also, that the new moon is always in the same part of the heavens with the sun, and that the full moon is in the opposite part of the heavens from the sun. Now, when the sun is at the winter solstice, it sets far in the south-west, and accordingly the new moon runs very low; but the full moon, being in the opposite tropic, which rises far in the north-east, runs very high, as is known to be the case in mid-winter. But now take the position of the ecliptic in mid-summer. Then, at sunset, the tropic of *Cancer* is in the north-west, and the tropic of *Capricorn* in the south-east; consequently, the new moons run high and the full moons low.

It is a natural consequence of this arrangement to render the moon's light the most beneficial to us, by giving it to us in greatest abundance, when we have least of the sun's light, and giving it to us most sparingly, when the sun's light is greatest. Thus, during the long nights of winter, the full moon runs high, and continues a very long time above the horizon; while in mid-summer, the full moon runs low, and is above the horizon for a much shorter period. This arrangement operates very favourably to the inhabitants of the polar regions. At the season when the sun is absent, and they have constant night, then the moon, during the second and third quarters, embracing the season of full moon, is continually above the horizon, compensating in no small degree for the absence of the sun; while, during the summer months, when the sun is constantly above the horizon, and the light of the moon is not needed, then she is above the horizon during the first and last quarters, when her light is least, affording at that time her greatest light to the inhabitants of the other hemisphere, from whom the sun is withdrawn.

About the time of the autumnal equinox, the moon, when near her full, rises about sunset a number of nights in succession. This occasions a remarkable number of brilliant moonlight evenings; and as this is, in England, the period of harvest, the



phenomenon is called the *harvest moon*. Its return is celebrated, particularly among the peasantry, by festive dances, and kept as a festival, called the *harvest home*,—an occasion often alluded to by our poets. Thus Henry Kirke White:

“ Moon of harvest, herald mild  
Of plenty, rustic labour's child,  
Hail, O hail! I greet thy beam,  
As soft it trembles o'er the stream,  
And glides the straw-thatch'd hamlet wide,  
Where innocence and peace reside;  
'Tis thou that glad'st with joy the rustic throng,  
Promptest the tripping dance, th' exhilarating song.”

To understand the reason of the harvest moon, we will, as before, consider the moon's orbit as coinciding with the ecliptic, because we may then take the ecliptic, as it is drawn on the artificial globe, to represent that orbit. We will also bear in mind (what has been fully illustrated under the last head), that, since the ecliptic cuts the meridian obliquely, while all the circles of diurnal revolution cut it perpendicularly, different portions of the ecliptic will cut the horizon at different angles. Thus, when the equinoxes are in the horizon, the ecliptic makes a very small angle with the horizon; whereas, when the solstitial points are in the horizon, the same angle is far greater. In the former case, a body moving eastward in the ecliptic, and being at the eastern horizon at sunset, would descend but a little way below the horizon in moving over many degrees of the ecliptic. Now, this is just the case of the moon at the time of the harvest home, about the time of the autumnal equinox. The sun being then in *Libra*, and the moon, when full, being of course opposite to the sun, or in *Aries*; and moving eastward, in or near the ecliptic, at the rate of about thirteen degrees per day, would descend but a small distance below the horizon for five or six days in succession; that is for two or three days before, and the same number of days after, the full; and would consequently rise during all these evenings nearly at the same time, namely, a little before, or a little after, sunset, so as to afford a remarkable succession of fine moonlight evenings.

The moon *turns on her axis* in the same time in which she revolves around the earth. This is known by the moon's always keeping nearly the same face towards us, as is indicated by the telescope, which could not happen unless her revolution on her axis kept pace with her motion in her orbit. Take an apple, to represent the moon; stick a knitting-needle through it, in the direction of the stem, to represent the axis, in which case the two eyes of the apple will aptly represent the poles. Through the poles cut a line around the apple, dividing it into two hemispheres, and mark them, so as to be readily distinguished from each other. Now place a candle on the table to represent the earth, and holding the apple by the knitting-needle, carry it round the candle, and you will see that, unless you make the apple turn round on the axis as you carry it about the candle, it will present different sides towards the candle; and that, in order to make it always present the same side, it will be necessary to make it revolve exactly once on its axis, while it is going round the circle,—the revolution on its axis always keeping exact pace with the motion in its orbit. The same thing will be observed, if you walk around a tree, always keeping your face towards the tree. If you have your face towards the tree when you set out, and walk round without turning, when you have reached the opposite side of the tree, your back will be towards it, and you will find that, in order to keep your face constantly towards the tree, it will be necessary to turn yourself round on your heel at the same rate as you go forward.

Since, however, the motion of the moon on its axis is uniform, while the motion in its orbit is unequal, the moon does in fact reveal to us a little sometimes of one side and sometimes of the other. Thus if, while carrying the apple round the candle, you carry it forward a little faster than the rate at which it turns on its axis, a portion of the hemisphere usually out of sight is brought into view on one side; or if the apple is moved forward slower than it is turned on its axis, a portion of the same hemisphere comes into view on the other side. These appearances are called the

moon's *libration in longitude*. The moon has also a *libration in latitude*;—so called, because in one part of her revolution more of the region around one of the poles comes into view, and, in another part of the revolution, more of the region around the other pole, which gives the appearance of a tilting motion to the moon's axis. This is owing to the fact, that the moon's axis is inclined to the plane of her orbit. If, in the experiment with the apple, you hold the knitting-needle parallel to the candle (in which case the axis will be perpendicular to the plane of revolution), the candle will shine upon both poles during the whole circuit, and an eye situated where the candle is would constantly see both poles; but now incline the needle towards the plane of revolution, and carry it round, always keeping it parallel to itself, and you will observe that the two poles will be alternately in and out of sight.

The moon exhibits another appearance of this kind, called her *diurnal libration*, depending on the daily rotation of the spectator. She turns the same face towards the centre of the earth only, whereas we view her from the surface. When she is on the meridian, we view her disc nearly as though we viewed it from the centre of the earth, and hence, in this situation, it is subject to little change; but when she is near the horizon, our circle of vision takes in more of the upper limb than would be presented to a spectator at the centre of the earth. Hence, from this cause, we see a portion of one limb while the moon is rising, which is gradually lost sight of, and we see a portion of the opposite limb, as the moon declines to the west. You will remark that neither of the foregoing changes implies any actual motion in the moon, but that each arises from a change of position in the spectator. Since the succession of day and night depends on the revolution of a planet on its own axis, and it takes the moon twenty-nine and a half days to perform this revolution, so that the sun shall go from the meridian of any place and return to the same meridian again, of course the lunar day occupies this long period. So protracted an exposure to the sun's rays, especially in the equatorial regions of the moon, must occasion an excessive accumulation of heat; and so long an absence of the sun must occasion a corresponding degree of cold. A spectator on the side of the moon which is opposite to us would never see the earth, but one on the side next to us would see the earth constantly in his firmament, undergoing a gradual succession of changes, corresponding to those which the moon exhibits to the earth, but in the reverse order. Thus, when it is full moon to us, the earth, as seen from the moon, is then in conjunction with the sun, and of course presents her dark side to the moon.

Soon after this, an inhabitant of the moon would see a crescent, resembling our new moon, which would in like manner increase and go through all the changes, from new to full, and from full to new, as we see them in the moon. There are, however, in the two cases, several striking points of difference. In the first place, instead of twenty-nine and a half days, all these changes occur in one lunar day and night. During the first and last quarters, the changes would occur in the daytime; but during the second and third quarters, during the night. By this arrangement, the lunarians would enjoy the greatest possible benefit from the light afforded by the earth, since in the half of her revolution where she appears to them as full, she would be present while the sun was absent, and would afford her least light while the sun was present. In the second place, the earth would appear thirteen times as large to a spectator on the moon as the moon appears to us, and would afford nearly the same proportion of light, so that their long nights must be continually cheered by an extraordinary degree of light derived from this source; and if the full moon is hailed by our poets as "refulgent lamp of night," \* with how much more reason might a lunarian exult

\* "As when the moon, refulgent lamp of night,  
O'er heaven's clear azure sheds her sacred  
light,  
When not a breath disturbs the deep serene,  
And not a cloud o'ercasts the solemn scene,  
Around her throne the vivid planets roll,  
And stars unnumber'd gild the glowing  
pole :

O'er the dark trees a yellower verdure shed,  
And tip with silver every mountain's head;  
Then shine the vales, the rocks in prospect  
rise,  
A flood of glory bursts from all the skies;  
The conscious swains, rejoicing in the sight,  
Eye the blue vault, and bless the useful  
light."—*Pope's Homer*.



thus, in view of the splendid orb that adorns his nocturnal sky! In the third place, the earth, as viewed from any particular place on the moon, would occupy invariably the same part of the heavens. For while the rotation of the moon on her axis from west to east would appear to make the earth (as the moon does to us) revolve from east to west, the corresponding progress of the moon in her orbit would make the earth appear to revolve from west to east; and as these two motions are equal, their united effect would be to keep the moon apparently stationary in the sky. Thus, a spectator at E, Fig. 37, page 159, in the middle of the disc that is turned towards the earth, would have the earth constantly on his meridian, and at E, the conjunction of the earth and sun would occur at mid-day; but when the moon arrived at G, the same place would be on the margin of the circle of illumination, and will have the sun in the horizon; but the earth would still be on his meridian and in quadrature. In like manner, a place situated on the margin of the circle of illumination, when the moon is at E, would have the earth in the horizon; and the same place would always see the earth in the horizon, except the slight variations that would occur from the librations of the moon. In the fourth place, the earth would present to a spectator on the moon none of that uniformity of aspect which the moon presents to us, but would exhibit an appearance exceedingly diversified. The comparatively rapid rotation of the earth, repeated fifteen times during a lunar night, would present, in rapid succession, a view of our seas, oceans, continents, and mountains, all diversified by our clouds, storms, and volcanoes.

*(To be continued.)*

THE CHARMS OF LIFE.—There are a thousand things in this world to afflict and sadden—but oh! how many that are beautiful and good! The world teems with beauty—with objects that gladden the eye and warm the heart. We might be happy if we would. There are ills which we cannot escape—the approach of disease and death, of misfortunes, sundering of earthly ties, and the canker-worm of grief, but a vast majority of the evils that beset us might be avoided. The cause of intemperance, interwoven as it is with the ligaments of society, is one which never strikes but to destroy. There is not one bright page upon record of its progress, nothing to shield it from the heartiest execrations of the human race. It should not exist—it must not. Do away with all this; let wars come to an end, and let friendship, charity, love, purity, and kindness, mark the intercourse between man and man. We are too selfish, as if the world was made for us alone. How much happier should we be were we to labour more earnestly to promote each other's good. God has blest us with a home which is not all dark. There is sunshine everywhere—in the sky, upon the earth—there would be in most hearts if we would look around us. The storms die away, and the bright sun shines out. Summer drops her tinted curtain upon

the earth, which is very beautiful, even when autumn breathes her changing breath upon it. God reigns in heaven. Murmur not at a creation so beautiful, and who can live happier than we?

WHAT IS DIRT?—Old Dr. Cooper, of South Carolina, used to say to his students, “Don’t be afraid of a little dirt, young gentlemen. What is dirt? Why nothing at all offensive, when chemically viewed. Rub a little alkali upon that dirty grease spot on your coat, and it undergoes a chemical change, and becomes soap; now rub it with a little water and it disappears—it is neither grease, soap, water, nor dirt. That is not a very odorous pile of dirt you observe there! Well, scatter a little gypsum over it, and it is no longer dirt. Everything you call dirt is worthy your notice as students of chemistry. Analyse it! It will separate into very clean elements. Dirt makes corn, corn makes bread and meat, and that makes a very sweet young lady that I saw one of you kissing last night,—particularly if she whitened her skin with chalk or Fuller’s earth. There is no telling, young gentlemen, what is dirt. Though I may say the rubbing such stuff upon the beautiful skin of a young lady is a dirty practice. Pearl powder, I think, is made of bismuth—nothing but dirt.”

## THE MIRROR OF NATURE.

*(Continued from page 137.)*

THE greater the distance through which a falling stone has to pass before it finds its firm resting point on the earth, so much the more rapid and powerful is its descent; when part of a mountain falls, those pieces of rock roll the farthest which descend from the greatest height. Thus, in such cases as are presented to us in the histories of intellectual development of Duval and Laura Bridgman, we cannot but see plainly that precisely the great obstacles, which the intellectual impulse has to overcome, give to that impulse a quite peculiar and unusual force. But that impulse urges every human being; we all have a natural desire of knowledge, whether the satisfaction of this desire be made easy or difficult. To us, indeed, in comparison with Duval, and still more with the blind mute Laura, it is given amidst the many means of obtaining knowledge placed within our reach, to get rich without great trouble; but should we, on this account, because it is made easy for us, leave those means unused?

I think not. It is good to get and to gain; and if we neglect the opportunity thereto, it must be, that we regard ourselves as already rich and satisfied, not as needy, while, however, it is hunger alone which gives to the food of life its relish and its nutritiousness. I hope that the following pages, which like little cups or dishes are to offer various viands to the desire of knowledge, may awaken in many a young mind a desire to help itself, and an appetite to partake of the feast.

## THE ALMANAC-SIGNS.

When Duval, in his younger years, while still at service in Clezantine as an ignorant shepherd, took up the Almanac, which always gave him so much to think of, his curiosity was often excited by those signs, which mark the sun and the planets as well as the several days of the week. That the moon sickle represented the moon, and among the days of the week, Monday, and the circle with a point in the centre, the sun, and in the week, Sunday, soon became known

to him. The evening star and the morning star, these too his employment as a herdsboy soon brought him acquainted with, and, at the same time, he learned that the little circle, which has a cross below it in the Almanac, represents these stars. Before, however, he learned to know the other more remarkable planets, Jupiter, Mars, Saturn, and their signs in the Almanac, a long time elapsed.

The insatiable curiosity of Duval did not permit him, as we have seen, to stand still with the knowledge of the constellations. Soon he wished to know how our earth looks, what is its size, and what lands and seas it consists of. Could the eager youth have had a look at such a globe as Charles William Kummer made in Berlin (a relief-globe), on which all the elevations and depressions, the mountains, valleys, and plains, are represented, with what delight would it have filled him! How at once would much have become plain, over which he long racked his head in vain. But such beautiful helps to learning, as are now so richly provided for the young, were not to be found then even in the school-rooms of royal princes.

Even with the study of Geography, although as long as he lived it was one of his most favourite employments, the inquiring mind of the young hermit was not satisfied. He procured books of the most opposite kinds, and precisely those whose contents and language were the most mysterious and dark, exciting his curiosity the most; with an admirable perseverance he tormented himself in trying to understand the writings of Raymond Lully, a celebrated scholar of the middle ages. In such books of the same period, which, by their pompous titles, and by their prefaces, promise to introduce the reader to all the mysteries of Nature,—the case especially with the works that treat of chemistry (then styled Alchemy),—one finds the same signs again, which in the Almanac represent the sun and planets, but here they are used very differently. For what in the Almanac stands for the sun, in those writings represents gold; the signs for the Moon, Venus, Mercury, Mars, Jupiter, Saturn, are by the old chemists used to denote silver, copper, quicksilver, iron, tin, and lead.

We should not regard with entire con-



tempt these double signs of the almanac-makers and the chemists. They merit a certain respect for their high antiquity; for they have passed through the hands of many people, and through a long line of centuries, ere they have reached us and taken their places in our almanacs. Astronomy is a primeval science. To the earliest fathers of our race, who, in mind and body, enjoyed the health of youth, who were not then distracted by the thousand-fold influences of our modes of life and the daily tidings of the press, but lived in still communion with nature like Duval, the herds-boy and hermit,—to them it happened as to him. the thirst for knowledge which was in them, turned first, above, to the starry heavens. As children, so soon as they can move their heads, turn most eagerly to the light and the moon, and struggle joyously with their little hands when they see anything shining, so also was the curiosity of men in the earliest times, attracted most powerfully by the shining stars of heaven and the glittering stones and metals of earth.

When Duval had become acquainted with the lands and seas on the surface of the globe, how gladly would he have learned still further what is known of that which is hidden in the depths. When an Indian or a poor boy takes in his hand for the first time in his life, a watch, and has for a long time wondered at the moving of the hands and the ticking of the mechanism, he would next gladly know what is inside the watch, and he often gratifies his curiosity to the great detriment of the work. So is it with the desire to know, which moves the human mind. It seeks to penetrate the depths as well as ascend the heights of all visible existence. Man seeks to know not merely *that* a thing is, and *how* it is, but he also inquires, *whence* and *by what means* it exists.

But to return once more to the almanac signs, which have the double signification of the stars of heaven and the metals. The interest which man takes in the metals did not arise accidentally from the use which could be made of them, or from the value gradually attached to them in exchanging them with other things; but that interest may have been created in another natural way, which it would lead us too far aside to explain. Physicians

and other observers know that the metals have a certain influence upon the internal organs of sensation (the nerves), and that in many conditions of disease, the attraction of metals is so great that the individuals afflicted are aware of the vicinity of metals, even when they do not see them. In such cases, it has appeared that some metals, especially gold, have a beneficial, while others, such as iron and zinc, exert a disagreeable, painful influence. The morbid affection for the metals, which we justly condemn as avarice, finds no excuse here, as we can in some degree understand the external cause of it, whence it proceeds.

We are speaking here, however, not of the relation in which the metals directly stand to the physical nature of man, but only of the relation they bear to the advancement of our knowledge of visible things. And in this view it may be said that these shining bodies, which do not indeed give out light of themselves like the sun, but like the planets, like the beautiful evening and morning star, powerfully reflect the light received from the sun, are as important to a knowledge of the earth as the celestial bodies, whose signs the science of antiquity has impressed upon them, are to Astronomy. The metals belong to those truly simple elements, out of which the terrestrial bodies of nature are composed; their examination prepares the way for us to a knowledge of the elements strictly so called. And, instead of directing our curiosity upwards to the stars, let us take the opposite path in the first place, downwards, to the elements of our earth, and then, from a firm foundation, we shall be able to ascend all the more successfully.

#### THE ELEMENTS.

The ancients recognised, as is known, four Elements: fire, air, water, and earth. Of these original substances, according to their opinion, all material bodies are formed. With our present scientific modes of speaking, the idea of four elements in the sense of original substances, is no longer admitted, for our chemistry has brought us acquainted, not with four, but with fourteen times four original substances of material bodies;\* and that

\* There are sixty-two elements known at present.

which we name, earth, according as we make a trial of it here or there, is composed of a greater or less number of substances; water of two; atmospheric air, when we take into view the vapour usually existing in it, consists of at least four substances. And with the three so-called elements, definable by weight and measure, the fourth, fire, is classed with as much propriety as virtue would be, if it were ranked with three articles of food or furniture, or if, with our present ideas of original substances, one should number fire among them, it would be as if he were to say that the human body consists of bones, flesh, skin, and *motion*. For fire is not, in the ordinary sense, a substance, but it is, in its nature, a motion of substance, as the tone of a piano-string, which the ear perceives, is not brass wire nor air, but a motion of the stretched wire and of the air, whose agitation acts upon our organs of hearing.

However, with our present insight into the nature of simple substances, we must not too severely condemn the ancient division of the four elements. There lies in this division a deep truth, as we may perhaps hereafter see, when we have first explained what is to be understood by simple substances.

#### SIMPLE SUBSTANCES.

A statue of marble, fashioned after the likeness of the human form, contains neither veins, nor flesh, nor bones, but when an accident or a barbarian hand breaks it into pieces, we find in all parts of it, from the head to the foot, from the surface to the centre, everywhere in and on it, nothing but white, granulous limestone or marble. When we break it into still smaller pieces, it remains everywhere and throughout the same; every grain, like the whole, is a white marble, and, examined by a powerful microscope, there are seen in the grain the same surfaces, the same brightness, the same colours that appear to the naked eye in a much larger fragment.

Nevertheless, the innumerable particles and grains, into which the block of limestone, to which the artist has given the human form, is broken, are by no means the substances of the mass, but every one of those grains is composed of several

substances. That this is so, every lime-burner knows, when he puts the marble into the fire. The lime loses then the water and carbonic acid with which this earth was combined, and this remains, as so-called pure calcareous earth or quick lime. But even this earth is no pure substance, but, as the further investigations of later times have shown, consists of a metal and a substance of atmospheric air of which we shall soon have more to say, and which is oxygen gas or vital air.

Vermilion, that beautiful, red, colouring material is known to every one conversant with painting. When by rubbing and bruising, a piece of vermilion is reduced to a powder, every particle of the same remains what the whole was, vermilion. But if one mingles with this trituated vermilion a quantity of iron filings, and exposes this mixture to heat, two different substances are immediately disclosed, sulphur and mercury; for the sulphur, which has a stronger attraction for the iron than for the mercury, combines with the iron and makes sulphuret of iron, and the mercury is set free from its previous combination.

The copper, from which a portion of the Russian copper coins, called *kopecs*, are made, comes from the rich Ural mines, and often contains in its combination a certain proportion of gold. Copper of this kind, which is found also, particularly in Japan, is distinguished from common copper, by its beautiful red colour, and great ductility, but when a bit of it is pulverised ever so finely, still every particle contains the same mixture of copper and gold as exists in the original mass. When, however, sulphuric acid, diluted with water, is put upon it, the copper is separated from the mixture, which becomes blue vitriol, and the gold remains as a fine sediment in its metallic purity, and may be melted back again into a combined mass.

In all these cases we observe that there is a two-fold force that brings together and unites the smallest parts or atoms of bodies. When birds of passage, moved by a common impulse, set out upon their far journeys, they collect in great multitudes. In spring too, before the time of pairing has arrived they still keep together in large flocks. But when the time to



build their nests has come, then the great masses separate into families. The natural instinct, which is the basis of this union by pairs and of the tender care of the young, is much stronger than the gregarious impulse, and the latter can only avail, when the stronger instinct releases the individuals from its ties, and then the power of that universal world-life seizes the flocks of individuals, and converts the union of individual beings into a union for the spaces and regions of the earth.

In a similar way, a universal attraction works in the union of the homogeneous parts of vermilion or of the gold mixed with copper; but in the union of the sulphur with the iron, or of the copper with the vitriolic acid, a peculiar and stronger attraction is the universal force. The power of cohesion, which causes the more or less firm connection of single parts, is of like nature with that universal attractive force, which, as gravity, unites the single masses of physical bodies into the globe. It may be neutralised by what are called mechanical means, as when, for example, a large stone by the force of its gravity crushes another and smaller one, or when the pressure, caused in this instance by gravity, is produced by the force of man's arm, or by his art. Chemical relationship (affinity) is based upon that polarization (sexual opposition) in which the special life and creative working of things everywhere has its beginning because it proceeds from the very source of life and creation. The power of cohesion has for its end and aim the preservation of things as they are; chemical affinity, on the other hand, a new formation. We have not yet arrived at the explanation of what is to be understood by simple substances. To this end we must make an apparent digression by considering more closely the metals.

#### THE METALS STRICTLY SO CALLED.

Could we transport ourselves at once away from the earth to those great spaces, which separate our globe from the sun and its planets, we should find there, at mid-day, no daylight. For here, upon the surface of the earth, the light of the sun is reflected from all bodies, even from the air, as the morning and evening twilight

shows us, whose light comes merely from the atmosphere before the tops of the mountains are illuminated. But there, in the planetary spaces, there is neither air, nor mountain, nor any other body to reflect the sunlight and thereby diffuse in all directions the light of day; for if the planetary spaces were capable of such reflection, we should never have complete night upon the earth. On that account, the human eye, turned in that immense space towards the sun, would see it as a bright disc standing on a dark, black background, and when turned in an opposite direction, it would see the stars upon the same dark ground. The beneficent, illuminating, warming influence of the sun can make itself manifest only when it meets bodies, which, by the polaric variation of their whole being from that of the sun, are the most susceptible of such an influence, especially such bodies as unite the greatest solidity with opacity.

Such bodies are especially the metals. In themselves devoid of light, and more than any other bodies, of heat of their own, they are, on this account, susceptible of being affected by light and heat; but not only by light and heat, but also by all the other powers of material life which are awakened by polarity, by magnetism and chemical affinity. The collected stone-masses of the mountains, which we see around us, have proceeded in their formation from a condition originally metallic; a metallic substance is their basis, which, united with the universal opposite of metallic natures, with the oxygen gas of the air, then becomes a kind of earth: the first movements of a self-dependent formation and fashioning take their beginning in the kingdom of the metals.

The sun in the heaven has in the terrestrial material world its opposite sun, in *Gold*. Its remarkable colour, its great brightness, showing itself on the rude surface of a lump of the metal by a slight polish, its great weight, its pliability (malleableness and ductility), under the hand of man, must have attracted attention to it in the earliest times. Gold was at first much more easily obtained than in our days, and it was wrought with much more ease than iron or copper. For only by a high degree of heat can iron be

melted out of the ore, in which it is found, not in a pure state, but mixed with other substances, while gold, on the contrary, came to hand in full purity, and might be hammered and wrought just as it was; the heat, required to make it fluid, is a great deal less than that required by iron. Besides, gold invited men to its use by the way in which it presented itself. For, although this precious metal was originally, like other metals, enclosed in rocky substances, yet by the crumbling to pieces of its original beds, it came to be found among boulder stones, and the sands of valleys and plains; and then its pliability saved it from being broken and crushed, while its peculiar gravity prevented it from being as easily washed away as the stony fragments and sand in which it lay bedded. The man, therefore, who came upon a rich spot of this sort, frequently found gold in lumps of considerable size, lying open to the day, or when, in the course of centuries, turf and forest had spread over a stone or sand field originally rich in gold, the discovery of the treasure was soon made, in the digging of a ditch, or by any other process which was calculated to expose the gold. In a way similar to this, the gold riches of a large, sandy surface in the Ural Mountains in Russia, remained undiscovered until some years ago, and then a significant idea could be formed of what the ancients say of the gold wealth of India and Arabia, and modern writers tell us of South America. In that Ural gold district was found in the year 1825, a lump of gold weighing eighteen pounds, and nine other pieces, each of which weighed several pounds. At Miasek, in the government of Orenburg, a lump of gold was found, seven pounds in weight. Although these masses are not to be compared with that piece of gold which was discovered in the year 1730, in Paz, in America, which weighed forty-five pounds, and out of which five thousand six hundred and twenty ducats were coined, nor with that again, dug up at Bahia, in the Brazils, in 1785, whose weight was two thousand five hundred and sixty pounds, and which was estimated in money-value at also a million and a quarter of guilders; yet the lumps of gold found in Russia were the most considerable, so far as his-

tory informs us, ever discovered in so northern a region. For when we consider what the ancients tell us of India or Ethiopia, or of the gold of Arabia, which was found in pieces of the size of a chestnut, and what is told of the masses of this metal found in hotter America, we come directly to the opinion that the countries between the tropics, or in their neighbourhood, are the almost exclusive home of gold.

Gold, even in the countries in which it is most abundantly found, is indeed, in comparison with other metals, a rarity. For although the amount of gold obtained yearly for the last three centuries from the rich Spanish and Portuguese possessions in America may be estimated at something more than a hundred and fifty cwt., yet this is not even the hundredth part of the silver which these countries produce in the course of a year, and, if we take only one country into the account, not the thirteen hundredth part of the amount of the copper, scarcely the sixteen hundredth part of the lead, nor the three thousandth of the iron, produced every year in the comparatively little country of England.

On account of its rarity, but yet more for its other advantageous qualities, this beautiful and shining metal has, from ancient times, maintained a value in exchange and trade, which exceeds about twelve times that of silver, indeed in our days somewhat more than fourteen times. If one of us were to find upon a desert island, or in fishing in the sea, a lump of gold, so heavy that we could not carry it a league without great exertion, he would have enough for himself and his for his lifetime, for every pound of gold is worth four hundred and fifteen Prussian dollars or seven hundred and twenty-seven Rhenish guilders.

*(To be continued.)*

**FORTUNE.** — In whatever country a man may hide himself, fortune and the malice of an evil man will be sure to find him out: for which reason, the soul ought to withdraw itself, into its impregnable fortress of constancy, whence if it looks with contempt on all human things, the darts which fortune and the world shall throw at him, will fall innocuous at his feet.



## ORGANIC CHEMISTRY.

## NUTRITION OF PLANTS AND ANIMALS.

THE animal creation is entirely dependent for its support upon the products of the vegetable. Plants assimilate inorganic matter, and give it a form which fits it for the support of animals. We may then properly consider; first, the nutrition of vegetables. The organic substances essential to plants are cellulose and proteine; these enter into the structure of the smallest vegetable, and are necessary to the formation of cells, which are the first rudiments of organic development. Besides these, plants may contain sugar, oils, acids, and resins, but these are not necessary to their constitution.

The proteine compounds contain small portions of sulphur and phosphorus, and the ligneous fibre is never destitute of inorganic salts; these are always found dissolved in the fluids of the plants, and are essential to its perfect development. Some of them are decomposed by the plants, to furnish sulphur and phosphorus for the albumen and other proteine bodies, but beyond this, little is known of the functions of these substances. The seeds of vegetables contain starch and proteine, which serve for the nourishment of the plant until its organs are sufficiently developed to enable it to support itself from external sources.

The food of plants consists of carbonic acid, water, and ammonia, in addition to the mineral salts already mentioned. These are absorbed by the organs of the vegetable, and are converted into cellulose and proteine; the power by which this is effected is unknown; chemical affinity is controlled and directed by the agency of life, so as to produce complex and highly organized bodies. We know, however, the substances which enter into combination, and the results of their action; in this way the formation of these bodies may be expressed by formulas.

The cellular tissue is formed from the elements of carbonic acid and water, by the separation of oxygen; twelve equivalents of carbonic acid, with ten equivalents of water,  $C_{12}O_{24} + H_{10}O_{10} = C_{12}H_{10}O_{10} + 10O$ ; or one equivalent of cellulose and ten of oxygen. In the formation of proteine, the elements of ammonia are

added to those of carbonic acid and water. Forty equivalents of carbonic acid with fifteen of water and five of ammonia = one equivalent of proteine and eighty-three of oxygen. It is well known that proteine, under certain circumstances, absorbs oxygen, and is decomposed into ammonia and humic acid. This last is formed from woody fibre, by the loss of the elements of water and carbonic acid; proteine may therefore be produced from cellulose, by adding ammonia and subtracting carbonic acid and water.

All the other principles of plants may be formed in a similar manner. Starch is identical in composition with cellulose, and yields sugar and gum by combining with the elements of water. Malic acid is formed from the elements of eight equivalents of carbonic acid and four of water, by the abstractions of twelve equivalents of oxygen, and the other acids are produced by an analogous process. It is probable that the saline and alkaline matters in the sap exercise some influence on these processes, and conduce to the formation of the various products.

The oxygen which is set free in all these reactions is evolved from the leaves in the form of gas. If a branch of any plant is placed under an inverted receiver, filled with pure water, and exposed to the sun's light, small bubbles of gas will appear on the leaves, which rise and collect in the upper part of the jar. This gas is pure oxygen, and is evolved by all healthy plants when exposed to the light; in darkness the process of nutrition is very imperfectly performed, and the carbonic acid absorbed by roots is given off from the leaves unchanged. If a plant is made to grow in a vessel containing a mixture of common air and carbonic acid gas, the latter will be slowly absorbed and replaced by pure oxygen. Plants have the power of absorbing gaseous carbonic acid and water through their leaves, as well as by their roots; they also exhale large quantities of water from the pores on the surface of the leaves.

A soil fitted for the growth of plants, must contain in a soluble form all the salts and mineral constituents which they require. These vary in different plants; their nature and quality are determined by minute analyses of the ashes of each vege-

table. The most important are potash, lime, magnesia, and iron, combined with sulphuric, phosphoric and silicic acids, and chlorine. Plants have the power to decompose these salts; we have observed that they separate sulphur and phosphorus to form the proteine compounds, and all of them contain salts of potash with vegetable acids, as in the grape. The alkali in these has been separated from its combination with the mineral acids; when the plant is burned, these salts are decomposed, and produce the carbonate of potash, which the ashes of vegetables always contain.

Many of the mineral substances are contained in the rocks, from whose disintegration the soil was formed, and their slow decomposition gradually liberates them in a soluble form. Often, however, by long cultivation, some particular ingredients of the soil become exhausted, and it is no longer productive. Its fertility may then be restored by the application of some mineral manures, as wood-ashes, or bone-dust. A soil which has become unfitted for the growth of one plant, may still contain the substances necessary to the support of another, and hence the utility of rotation in crops. The ashes of tobacco contain a large amount of potash, while wheat and other cereal grains abound in phosphate of lime; so that a soil well adapted to the growth of tobacco may not be suited to wheat, and *vice versâ*.

Fertile soils generally contain, in addition to these, a portion of humus from the decomposition of vegetable matter. This is beneficial by its slow decomposition, by which it is constantly evolving carbonic acid, and by the ammonia that it contains. It thus presents a constant source of these substances to the roots of plants. We have stated that humic acid, or humus, not only combines with the ammonia of the atmosphere, but is able to form it by the direct absorption of nitrogen. Many chemists maintain that humic acid itself constitutes a part of the food of plants, and that it combines with the elements of water and ammonia to generate the various products of the vegetable organism. This view has been ably defended, but we have no evidence that it is absorbed by plants, while it is certain it is not necessary to their growth. There are many

plants which are capable of growing without any connection with the soil; they may be suspended from the ceiling, and will continue to grow luxuriantly for years. In these plants the process of nutrition is apparently the same as in those which derive their support from the earth. They absorb carbonic acid, ammonia and water, from the atmosphere, and form ligneous fibre and proteine like other plants. The amount of mineral matter which they contain is small, and is doubtless derived from dust constantly floating in the atmosphere, which collects upon the leaves, and is dissolved and absorbed. We have here vegetables subsisting entirely upon the ingredients of the atmosphere, and the results of experiment seem to show that all plants are nourished by the same substances, and that the only agency of humus is to afford carbonic acid and ammonia.

From what has been stated, it is easy to understand why ammoniacal salts are such efficient fertilizers of the soil. Plants watered with a weak solution of the sulphate, or any other salt of ammonia, grow very rapidly, and often attain twice the size and strength of those growing without this treatment. The beneficial effects of guano and urine are due, in part, to the ammonia which they afford. Guano consists in the excrements of sea-birds which resort in great numbers to small rocky islands on the coast of South America and Africa. The recent excretion consists of urate of ammonia, with various inorganic salts, but the uric acid is gradually decomposed and affords oxalate of ammonia. Wheat manured with guano is found to contain a quantity of azotized matter, twice as great as that raised on the same soil without any manure; this is attributable principally to the absorption of the ammonia.

The food of both herbivorous and carnivorous animals consists of proteine in its various forms, with starch, sugar, fat, and gelatine. Those subsisting on vegetables, appropriate the albumen and fibrine which these bodies contain, for the formation of muscular tissues, that finally become the food of carnivorous animals. The proteine compounds, which alone can form blood and muscle, are obviously distinguished from the non-azotized substances



that constitute a large portion of the food of many animals. Liebig conveniently designates them as the *Elements of Nutrition*, while gelatine and all non-azotized food are called *Elements of Respiration*, as they are supposed to be in a great measure consumed in that process.

The nature of the digestive process we are well acquainted with. The substances taken as food are reduced by the fluids of the stomach to a state of solution. They then pass into the small intestines, where the lacteals take up the portions which have been rendered soluble, and fitted for the purposes of nutrition. The saccharine and farinaceous portions of the food have never been observed in the chyle, but the blood, shortly after the saccharine substances have been taken into the stomach, contains a very appreciable quantity of them. It is well known that water and saline fluids are directly absorbed by the blood-vessels of the lining membrane of the stomach, and it is probable that alimentary substances in a state of complete solution are taken into the circulation in the same manner. These soon disappear from the blood, and are supposed to be oxydized in the lungs.

The non-azotized matters taken into the stomach are probably in part converted into fat. The most complete and satisfactory experiments have proved, that fat is really formed in the system, and is not, as was formerly supposed, derived from that contained in the food. Geese fed upon corn, are found to secrete an amount of fat much greater than is contained in the maize eaten by them, and bees form wax if fed upon sugar. We are indeed able to form one of the fatty acids of butter (butyric acid), from starch or sugar by fermentation. It is only by supposing it to be formed in the alimentary process, that we can account for the constant presence of fat in the chyle.

The proteine compounds in the chyle require merely the organizing power of the vital force to give them the form of muscular tissue.

In the living body there is a constant waste of the tissues; the chemical forces, aided by the agency of the oxygen of the air, are producing a transformation of the muscular and adipose substances into simpler products, which are excreted from

the body in various ways. Baron Liebig has shown that a simple relation exists between the composition of the muscular fibre and the elements of the bile and urine; so that choleic acid and urea may be formed from it, by the addition of a little oxygen. The urea and uric acid contain the more azotized portions, and the bile those which are rich in carbon. The fatty tissues on the contrary appear to be completely converted into carbonic acid and water. The object of nutrition is to preserve the equilibrium of the system by supplying the waste of the tissues, and so long as this balance is maintained, the organism is in a healthy condition. When the amount of non-azotized food is greater than is consumed in the process of respiration, the excess is secreted in the form of fat, and sometimes increases to an enormous extent, as is seen in the fattening of domestic animals. If, however, the supply is stopped, the reverse process commences; the secreted fat is taken into the system and oxydized, and as there is no way to supply its loss, is soon completely absorbed.

*The act of respiration* has for its object to bring the blood into contact with the oxygen of the atmosphere. In the higher order of animals, this is accomplished through the lungs. These organs have a cellular structure, and are composed of a great number of cavities capable of inflation with air. Over the surfaces of these are spread the minute branches of the pulmonary artery, and the blood is consequently brought into close contact with the air. In the process oxygen gas is absorbed, and carbonic acid gas expelled. The relative proportions which the oxygen absorbed, and the carbonic acid exhaled, bear to one another, are determined by the law of the mutual diffusion of gases already mentioned. By this law, the volumes of any two gases which pass through a porous medium to mingle with each other, will be in the inverse proportion of the square roots of their specific gravities. The volume of oxygen that passes inward, will exceed that of the carbonic acid which passes outward, in the proportion of 1174 to 1000. As carbonic acid contains exactly its own volume of oxygen, it follows that 174 parts, or nearly fifteen per cent. more of oxygen are absorbed by the

lungs than are given out in the form of carbonic acid. A portion of this excess of oxygen unites with the sulphur and phosphorus of the original components of the body, converting them into sulphuric and phosphoric acids, and the remainder probably combines with the hydrogen of the fatty matter to form part of the water which is exhaled from the lungs.

The changes produced upon the blood by respiration have been already described. This process is essential to life, and even in the lower orders of marine animals, is effected through the aid of oxygen dissolved in the water. Experiments have shown that the amount of carbon given off from the lungs by a full-grown man, is about seven ounces in twenty-four hours. This oxydation, or slow combustion of carbon, must necessarily evolve heat, and is doubtless one source of the heat of the animal system; but the temperature of living animals is due in part to the other changes which are going on in the organism. In some cases of disease, when the respiratory function has been almost entirely suspended for hours, the temperature of the body has remained undiminished.

Vegetables have to a certain extent the power of maintaining a temperature above that of the atmosphere; this is particularly observed in the leaves and young shoots, where vegetation is most active. In the flowering of some species of *Arum*, a thermometer placed among the spadices has been observed to rise to  $121^{\circ}$ , when the temperature of the atmosphere was only  $66^{\circ}$ . Experiments have shown that in this case it is due to the absorption of oxygen, but it is hardly probable that such is the general cause. When we consider that heat is evolved in very many changes which are often independent of the absorption of oxygen, there is no difficulty in accounting for its production in the processes of nutrition and assimilation.

It is, however, true that in health, the oxydation of carbon may be taken as a measure of the heat evolved. The inhabitants of Greenland and other northern countries consume in their food immense quantities of fat and oil, and voyagers in these regions, have found such a diet not only healthful but even necessary, to enable them to endure the intense cold to which they were exposed.

In those animals which subsist entirely upon flesh, the amount of oxygen absorbed is not less than in the herbivorous, and the oxydizing process is at the expense of the muscular tissue. The waste of this is consequently much greater than in those animals subsisting upon a mixed diet, the fat and starch of which supply the demands of the respiratory process.

The lifeless particles of the inorganic world are assimilated by plants from the atmosphere, the soil, and the waters. Once taken into their structure, they are transformed by the vital force into woody fibre, starch, sugar, and proteine, which afford the materials for the nutrition of animals, and supply the constant demand of the respiratory functions. By the regular processes of life these are again set free in their original forms of carbonic acid, ammonia, and water, and are once more ready to enter the upward current of organic life.

By a beautiful adjustment of these organic forces, the balance of the two great kingdoms of nature is maintained. The carbonic acid set free by the processes of combustion, and the respiration of animals, fails to vitiate the purity of the atmosphere, because the vegetable kingdom appropriates all the carbon of this gas for its own support, and restores an equal volume of pure oxygen to the air.

The mind rests with equal pleasure and admiration on these beautiful laws, which silently, but unceasingly, work out an expression of the Almighty Will.

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HOW TO MAKE CANARIES FAMILIAR.  
—If you wish—as *all* who truly love birds must wish—to make your “pets” familiar, give them every now and then a small quantity of yolk of egg, boiled hard; and a small quantity of “German Paste” mixed with a stale sponge cake. Put this, lovingly, into a little “exclusive” tin pan, fitted in a sly corner of the cage, and the treat will have a double charm. These innocent little creatures love to flirt with any nice pickings thus mysteriously conveyed to them; and they will keep on chattering to you in a language of their own, for many minutes, while viewing the operations in which you are actively engaged for their particular benefit.—*Kidd*.



EASTERN RAMBLES AND  
REMINISCENCES.

## RAMBLE THE TWENTY-FIFTH.

GREECE — OUR INTRODUCTORY BOW TO  
ACHAIA — SEA LIFE IN NOVELS, NOT  
THE SAME AS THE ACTUAL THING—  
YACHT LIFE — MERCHANT VESSELS —  
GUARD-SHIPS IN THE NAVY — SEA-  
GOING SHIPS — ORIENTAL COMPANY'S  
SHIPS—YOUNG LONDON ABROAD—RO-  
MANTIC IDEAS, NOT REAL ONES—THE  
MODERN ENTRANCE TO THE PEIRÆUS—  
THE LONG WALL.

"Look! on the Ægean shore a city stands,  
Built nobly, pure the air and light the soil,  
Athens! the eye of Greece, mother of arts  
And eloquence, native to famous wits,  
Or hospitable in her sweet recess.  
City or suburban studious walks and shades!  
See there the olive groves of Academe,  
Plato's retirement, where the attic bird  
Thrills her thick-warble notes the summer  
long.

There, flowery hill, Hymethus, with the sound  
Of bees, industrious murmur, oft invites  
To studious musing: there Ilissus rolls  
His whispering stream. Within the walls the  
view

The schools of ancient sages: his who bred  
Great Alexander to subdue the world.  
Lyceum there and painted Stoa next."

MILTON.

"Immortal Athens first, in ruin spread,  
Contiguous lies at port, Lio's head;  
Great source of science! whose immortal name,  
Stands foremost in the glorious roll of fame."

FALCONER.

At daybreak, one morning in January,  
our ship anchored in the Peiræus  
of Athens. And we made our introduc-  
tory bow to Greece.

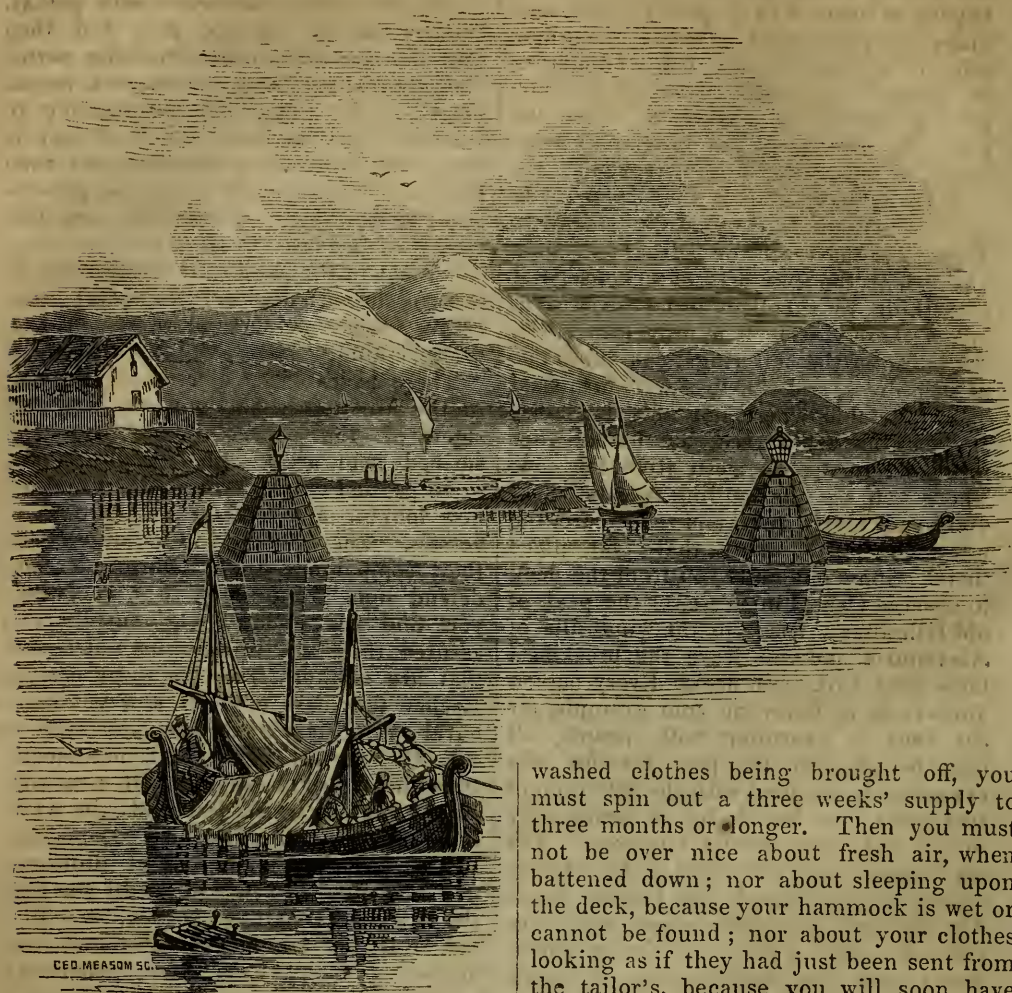
I was heartily glad to be once more  
at rest, for the last three weeks was nothing  
but a succession of unpleasant sea-adven-  
tures, with which I will not trouble my  
readers.

By the way it is worthy of remark,  
that sea life in reality, and sea life in  
novels, are two very different things. In  
the former you are uncomfortable, in  
the latter everything is either very jolly or  
very romantic. Now it sometimes happens  
that a yacht nicely trimmed, and well  
manned with pet sailors, issues from  
the smooth waters of Southampton, or  
Plymouth, and ventures to sea—of course

in the summer time. There are plenty  
of ladies on board with lots of Berlin  
work which they intend to finish before  
they return to England, and heaps of  
guide-books. Dictionaries and grammars  
(which they never look at), drawing-books,  
&c., nice young men, in what they face-  
tiously call "loud patterned trousers,"  
who always dress for dinner and breakfast,  
curl their whiskers and dye them when  
necessary, sip their wine and coffee, sport  
an eye-glass, and pronounce that "Miss  
Flame-ing is a doocid foyne geyerl, but  
she is so mortal stuck up," wear shining  
black hats and fancy themselves sailors.  
You may find a decent old naval officer  
on board one of these craft, who grumbles  
and tries to go a-head, but without success,  
for no sooner does the sky look gloomy,  
or a breeze spring up, than the owner  
of the yacht, tormented by the host of  
fine-weather birds, tells the master it's  
going to blow, and he must run in some-  
where until it holds up. Forthwith the  
Berlin work is dropped, and with it down  
goes the hands of all the ladies, out come  
spy - glasses, soda - water bottles, pale  
brandy, and great coats; the young men  
look solemn, the ladies look pale, and  
if you venture to smile, that nice young  
man who said last night that he "dreamt  
he dwelt in marble halls," and persisted  
afterwards in telling us all several times  
that he was afloat on the wild raging  
sea, comes up to you and says, with  
his whiskers uncurled, mind you that a  
joke is a joke, but that he does not see  
anything to smile at, when people are  
in such a situation, as all of us are at  
present. Bah! I hate muffs, and fresh-  
water-sailors (I hope nautical men will  
excuse the term). Let black-whiskers,  
bandoline, Berlin - wool - work, brandy,  
and balls, remain in their proper places  
on shore.

There are other kinds of sea-life that  
are worthy of remark. First, there is  
that in a merchant vessel where you meet  
with every species of discomfort and dirt;  
then there is the general routine of na-  
val life, which may be divided into loung-  
ing in guard-ships, and actual service at  
sea.

The pets of the navy—the guard-ship  
gentlemen—can tell you who gives the  
best pic-nic, and makes the best lobster



VIEW FROM THE PEIREUS, SHOWING THE  
ENTRANCE.

salad; whether Mrs. Smith's parties are better than Mrs. Brown's; the last good thing that was said at the Governor's or the Admiral's; all about the New Opera, and what singers are engaged for the next season; and what girls are to be married, and those that are not, who have "tin" and those that have not got "a dump."

Now, actual service at sea in the navy is just the sort of thing that will disgust a naval pet, for you must be ready at an hour's notice to take a voyage round the world, whether your traps are ready or not, and must learn to economise your wardrobe, so that if the ship sails without your

washed clothes being brought off, you must spin out a three weeks' supply to three months or longer. Then you must not be over nice about fresh air, when battened down; nor about sleeping upon the deck, because your hammock is wet or cannot be found; nor about your clothes looking as if they had just been sent from the tailor's, because you will soon have them adorned with patches of tar, grease, or paint; nor about your dinner, because perhaps just as you have taken the second mouthful all hands will be turned up, and after half an hour's exercise on deck you will return to find flakes of fat floating in your plate, and your dinner all cold, or perhaps worse—lying on the deck: nor about sea-sickness, for if you happen to get into a symondite that pitches and rolls well, you will soon feel queer, to say the least of it; in fact you must make up your mind to greasy decks, creaking bulkheads, broken rest, badly cooked meals, cockroaches, short allowance of water, and the discomfort of standing off and on a coast under treble reefs, and a storm try-sail, battened down for a week or ten days. To be sure, this state of things is



not always going on, but then you must expect to meet with it pretty often, and make up your mind to vary it occasionally to the ship running foul of another in going in or coming out of harbour, getting ashore and having to throw the guns, &c. overboard, and pump out all the water, or finish with being wrecked.

A far different affair is the voyage made in the Oriental Company's steamers. There you have all the advantages of a yacht, with the comforts of a house, and everything in excellent order; a trip in one of these vessels is a jolly thing. In the morning the bell rings, you jump out of bed, dress, and run to a well-furnished breakfast-table, where not only delicacies and dainties are served, but homely hot rolls, and good milk fresh from the cow. There you see the smiling faces of children, and pretty girls, and many are the interesting little chats that take place there. Some one hails you from the deck to observe Cape Finisterre, or the peak of old Gibraltar's Rock, or the windmills of Alexandria, and you leave the breakfast-table for a walk upon deck. Every person appears to be following your example, for the deck is swarming with people, all look happy, even the poor invalids who are going to the East with the intention of recruiting their health, but in reality only to end their days among strangers. The sea hisses around the vessel as she rapidly urges her way through the leaping mass. The fast men light their cigars, and order pale ale; after which they locate themselves upon the paddle-boxes, to inhale the fragrant weed, chat, or read "Murray's Hand-book." Presently luncheon appears, and then there is more eating, drinking and flirting,—which latter is again adjourned to the deck, unless it blows or rains, and then a song is requested of that pretty little girl in the flaxen ringlets, who is always whispering to the one with dark hair plastered to her face, and looking so amiable and sly; she consents, and the flirtation goes on admirably by means of "Drink to me only with thine eyes," and other songs equally expressive and sentimental. Dinner is too busy a time for aught but the clatter of knives, forks, and delf ware; the pops of corks, and an occasional joke from a man who will perpetrate these to the annoyance of all the

rest. After dinner the nimble-footed passengers amuse themselves with polkas, country-dances, waltzes, &c., and then succeeds tea, whist, chess, smoking, yarns, Berlin work, growling, newspapers, magazines, supper, grog, and the warning to put out lights and turn in. Each day is thus, until the port is reached, and then the vessel disgorges her cargo and passengers to be widely distributed over this earth's huge crust.

"What in the name of Fortune has all this to do with Eastern Rambles?" exclaims some person, and we answer, "Everything."

There is scarcely a port that you visit in the Mediterranean, but you will find some of the characters we have described; some are still on board the yachts, or ships, and others have just left and are now looking out for hotels, lodgings, or vessels. They claim you as their own, their companions, their countrymen, but defend some from the mass; for, where you find one good T. G., you may rest assured there are ninety-nine not far off, that are neither *verte*, nor *rouge antique*. Eschew the mass of T. G.'s, if you are a naval or military man, aye, and even as a T. G. yourself: for now, since steam-travelling is so cheap, you will meet with Young London at the Pyramids, the Acropolis of Athens, Jerusalem, Damascus, Venice, &c., as readily as at Rainsgate or Greenwich, and he will accost you with the universal, "'Ot day to-day, sir! Fine hair this for taking constitutional *hex*-ercise." You shrug your shoulders, mutter some reply, and walk away; but Young London is not to be done, he walks after you with a supercilious air and mincing gait, thinking that he has made a decided hit, and says, "Pray, sir, can you tell me what they call this here place?"

This! Oh! yes, it is the Peiræus of Athens, which was capable of containing 1,000 triremes in former times, when the Greeks were in the zenith of their power, and the celebrated —

"Oh! thank you, sir; but it does not look very large, nor very pretty, and I like the Londen-docks a precious deal better, 'only one likes to see foreign lands, and such like, and so I came out 'ere, but really it's an 'orrid place. The 'ouses are so much worse than those in

Hingland; the boats *habominable*, and the cabs look just like our *hone*."

Glad to be rid of such a nuisance as my Young London acquaintance, who bored me to anger, I rushed into a café in the Peiræus as soon as we had landed, and gulped down a cup of coffee.

My mind had long been dwelling upon the beauties of Athens, and, perhaps, some of the poetry of Byron had influenced my imagination; nay, I am certain that it had, because, for the last three weeks I had been dreaming of all sorts of bright skies and beautiful women; and had even gone so far as to be detected repeating,—

"Not in those climes where I have late been straying,

Though beauty long hath there been matchless deemed;

Oh! let that eye, which, wild as the gazelle's,  
Now brightly bold or beautifully shy,  
Wins as it wanders, dazzles as it dwells,

By that lip I long to taste;  
By that zone-encircled waist;  
By all the token flowers that tell  
What words we never speak so well;  
By love's alternate joy, and woe,  
*Ζών μου, σας αγαπῶ.*

and many other portions relating to the Achaia land. I thought of the long list of heroes, philosophers, poets, statesmen, sculptors, &c., that had adorned the roll of fame of Greece. I dwelt upon the glorious victories of Salamis, Plataea, Chæroneæ, Marathon, and Leuctra; upon the new ones of the past and of the modern ages, and had expected to see all that my fancy had painted, but, alas! I was doomed to be disappointed. The poetry and romance of Greece have faded, and now all is hard matter of fact, unless it be some few ruins, some sunsets, and classic spots that recal the deeds of former days.

Our ship had passed safely between the two pilasters at the entrance of the Peiræus, upon which two lamps have very wisely been placed; but it would be much better for all parties if they were always kept trimmed. Around were the Greek boats with fruit, and all kinds of eatables, and with the owners ready to cheat any and all, if possible. A violent thunder-storm came on shortly after we anchored; we did not feel inclined to venture on

shore, but took a general view of the harbour and the distant mountains towards Salamis. The view was novel and somewhat picturesque, and therefore, I took the sketch of it that heads this ramble. In the foreground were the bum-boats with provisions, and beyond them the two pilasters at the entrance of the harbour; on our left was the powder magazine, with its red-tiled roof and the coal-stores behind, and between the pilasters was the rock we so narrowly escaped as we entered the Peiræus. Beyond all were the mountains around Salamis and Egira, with the smooth blue sea, dappled over with boats, having long and peculiar sails.

When the storm had cleared off I hastened on shore with others of our ship, and here, meeting with our young London acquaintance, we speedily determined to be off to Athens. At first we determined to ride in one of the crazy old cabs that ply between Peiræus and august Athena, for half a drachm, ( $4\frac{1}{2}$ d.) each person, or one drachm and a half the vehicle, but as I wished to see the celebrated long walls or *μακρά τεῖχη*, we all agreed to walk, especially as the distance from the Peiræus to Athens is only about five miles.

In about five minutes after you have left the Peiræus, you arrive at the foundations of the celebrated old long walls, and it does not require any very great ingenuity to trace their foundations. No doubt you remember that the northern wall was built by Pericles, and that it contained 40 stadia. Themistocles, the victor of Salamis, built the southern one of large square stones, which were fastened together with iron and leaden clumps, and not with mortar. It was originally only about 60 feet (40 cubits) high, but Themistocles raised it to 120 feet. Its length was 35 stadia,\* and no doubt it looked well in the palmy days when both walls were ornamented by a number of turrets erected upon their summits. These however became so numerous afterwards, that the Athenians were obliged to convert them into ordinary lodgings. The walls that encompassed the Munychia, and joined it to the Peiræus, contained 60 stadia, and the wall on the other side, which

\* The *stadium* of Eratosthenes is estimated at  $\frac{1}{10}$ th of an English mile, and Posidonius makes an English mile to contain  $9\frac{1}{2}$  stadia.



was the outermost wall, was 43 stadia in length. Nothing now remains to confirm the magnificence of Macra Stoa, or the five porticoes of the Peiræus, which were joined together to form one grand one. They are swept away, and the two forums and other interesting spots are now almost forgotten amid the bustle of commerce and destruction of antiquaries.

### DUTIES OF PARENTS.

It is a matter of surprise that in the general awakening to the importance of the subject of education, the duties of parents are not more strongly felt. Even among those characterised as the friends of education, the interest manifested impels little or no further than to induce them to send their children regularly to school; and when this is done, they appear to think that nothing more is required of them. This apathy and indifference to the success of their children, though always criminal, was somewhat excusable a few years since when education was considered a matter of minor importance; but now, when it has become a subject worthy of engrossing the attention of the wisest and best of mankind; when the public mind is awakening to the importance of the subject, such neglect is unpardonable. The parent who thus carelessly suffers his child to proceed with his education, taking no pains to encourage him, or even to mark his progress, is guilty of wasting the mind of the child committed to his charge, and for which he will be held accountable.

Parents do not seem to know that the impressions which their children receive at school may make them happy or miserable, not only in time, but through eternity; consequently, they are not careful to visit the school and observe whether the moral as well as intellectual education of their children is cared for, or whether they are suffered to imbibe and practise all the evil doctrines attendant on that too often "seminary of vice"—the district school. Parents should visit the school frequently. It is a duty they owe not only to their children, but to their teacher.

The occasional presence of parents, while it stimulates the scholars to renewed exertions, will greatly cheer and encourage him. It will show that he is not alone in

his endeavours to impart instruction to the children of his charge. Parents should confide in their teacher. If differences of opinion exist with regard to different methods of instruction or government, they should be very careful not to injure their children by speaking disparagingly of their teacher. If his plans are supposed to be ineffectual, he should be told so plainly and kindly, and better ones should be proposed. And even if these do not meet with their approbation, they should beware of condemning what they do not understand. It should be remembered that the responsibilities of a teacher are great, and due respect should be given to his opinions.

If he is faithful and conscientious in the discharge of his duty; if he sedulously endeavours to promote the moral and intellectual education of the children committed to his charge; if by means of instruction received from him they become useful members of society, they owe him a debt which money can never pay. If parents realized the weight of responsibility resting on them, they *could* not manifest such utter indifference to the education of their children. May the time soon come when the importance of a good education shall be properly appreciated, and when all things else shall be held in subservience to the one all-important subject,—the education of the immortal mind. T.

### PRACTICAL HINTS TO TEACHERS OF SCHOOLS.

LET your first aim be to make your school pleasant and attractive. A cheerful countenance and kind words will do *much*. There are flowers of all kinds up the hill of science; find these flowers, and point them out to your pupils, and you may make your school the most agreeable place in the world for children. Accomplish this, and you have the secret of securing a regular and punctual attendance.

For young children, everything should be *short* and *simple*. *Short sessions; short lessons; short recitations*; and everything short, save *recesses*. These may be long; for children soon get tired of restraint. Too long confinement is injurious. Interest them by showing things, and talking about things. Cause them to

think and exercise their senses. Ask them many questions, and allow them to question you.

By all means have *order*. Order in studies and recreations; order in going to and from classes; order in entering and leaving the school-room. Teach the children to observe order in putting away their hats, bonnets, shawls, and in the care of their books and desks. The best schools, like the best machinery, move on with little noise. The most important *practical* direction in establishing and maintaining good order is, *Do not make much noise yourself*. A bustling, noisy teacher will make a bustling, noisy school. But do not make *order* and *silence* the *end*; they should be the *means* in education. Bees when most busily at work, generally buzz a little, so do boys. Let the *little* noise made be the *hum of business*, and not the *buzz of confusion*.

EMPLOYMENT is the great secret of maintaining order among children. It prevents mischief, relieves tedium, renders the schoolroom attractive to them. But this must be interesting employment. The use of slates and simple drawings is one of the means of furnishing it.

Interest your pupils in their studies. If you try to teach children who are not interested, it is like a blacksmith trying to make nails out of cold iron. There is too much hammering of cold iron in our schools; too much *hard* work, that does little good, because not rightly employed. Let all lessons be *well learned*, and then *review* often. Ask interesting questions—questions not found in the book, and thus wake up ideas, and make dull eyes bright by developing thought.

In hearing recitations, do not talk too much yourself. Let the *pupils* do most of the talking. Do not ask what the lawyers call leading questions, which may be answered by yes or no. Some teachers talk of *carrying* a class through a book; this must be the way they do it, by asking leading questions. Children are not apt to go alone as long as they can be carried. Few scholars will take the trouble to get their lessons *thoroughly* while they are sure that the teacher will so multiply and arrange his questions as to *suggest* what the answers should be.

We do not object to explanations on

the part of the teacher. He should, by all means, fully and clearly explain every thing not perfectly understood by the pupil; but we *do* object to the teacher doing *all* the work, and leaving the mind of his pupil in a passive state, to receive whatever he sees fit to pour into it. Our idea is simply this: at recitations, *scholars should explain more*, and *teachers should explain less*; for it is then the business of the *pupils* to tell what they know about the lesson.

Let your motto be, "A few branches, and *well*." Discipline mind by thorough, efficient teaching. The apparent advancement of your pupils may be slower than those of the more superficial teacher, but it will, in like proportion, be surer and more lasting. Aim, in all things, to secure the utmost accuracy.

Arrange your pupils into classes as much as possible. It is a vast saving of time, for you can thus act upon many minds at once. Pupils, when classified, have a greater stimulus for improvement than when reciting singly and alone, as was formerly the almost universal practice in our common schools.

Give much attention to the morals and manners of your pupils. You will find an abundance of occasions every day for inculcating correct principles in their minds without giving them sermons on the subject. Incidents will occur by which you can impress the value and importance of always speaking the truth; of honour to their parents; of kindness to each other; of respect to those who are older; of neatness and order. You can do much to discountenance pride, vanity, sauciness, vulgarity, and selfishness, and to encourage the opposite virtues. These incidents may occur in the schoolroom; they may be suggested by reading-lessons, or by recitations; but let them occur, however, and whenever they will, no fit occasion for moral instruction should be allowed to pass unimproved.

We have here endeavoured to give a few general hints relating to the management of schools. There is not a more interesting or noble work than that of rightly moulding the youthful mind; and we hope we have given here such suggestions as will be useful to teachers, and render them efficient aid in their important duties.



## ARTESIAN WELLS.

As much is now said about these wells, and as they are coming into extensive use in some parts of this country, as well as in Europe, an account of their origin, the manner in which they are made, and their advantages over common wells, may be interesting, particularly to the young reader.

In the first place, an Artesian well is very different from the common well; as much so, indeed, as are *springs*, which, in fact, they are, being formed by causing the water to rise to the surface of the earth, and to flow out in the same manner as a common spring. A cylindrical perforation, of a few inches in diameter, is *bored* vertically into the earth, until it reaches water that rises to or near the surface of the ground.

Artesian wells, though just coming into use in some places, is of much greater antiquity than may be generally supposed. The period when they originated is not exactly known, but the first are believed to have been made in the ancient town of *Artois* in France, whence originated the name of *Artesian*. They are, no doubt, of considerable antiquity, and have been known and used for several centuries in the north of Italy, and northern portions of France; but they were not known in Germany and England until some fifty or sixty years ago.

There are now a great many of these wells in the city of London and its neighbourhood. The water is procured in those there by perforating through the thick bed of London clay, and through some portions of the subjacent chalk. The water that rises, is found, generally, in a porous gravel bed, upon which the clay or chalk rests.

As the earth has generally to be perforated several hundred feet, to cause the water to rise to the surface, or within pumping distance, these wells afford much insight into the geological structure of the earth, in the different countries where they are made. In fact, the successful perforation of the earth, to obtain water in them, requires considerable acquaintance with the geological structure of the several districts or countries in which it is desirable to make them; as one or more of the geological

strata has to be passed, and the desired water occurs principally at the separation of two contiguous formations.

Another thing important to successful operation in boring these wells, is a skillful direction of the processes by which the water level can be reached, and those by which its ascent in the tube can be best promoted.

The operations which have to be used in boring for water in Artesian wells, are similar to those practised by the miner in boring for metals. The instrument employed is not similar to the common auger, as might be inferred from the term *boring*. It is in fact, more like a *chisel* than an auger, and in its operation similar to a pecking instrument.

This is fastened to the end of a pole-like, cylindrical piece of wood, which is made to operate from the end of a sweep, or raised and let fall in the same manner by the revolutions of a wheel with cog-like appendages for this purpose, or on the end of a short lever. As the depth increases, other pieces are added, and by a constant revolution of the instrument round, as it works, the hole is literally *pecked* or drilled out. Or a series of large, strong iron rods may be employed in the same manner.

Occasionally, as may be necessary, all are taken out, and the hole cleaned by a suitable cylindrical instrument, collecting and retaining the matter loosened, until drawn out; when operations are again renewed. These are thus continued until the desired water is reached.

As sand has sometimes to be penetrated through to the depth of several feet, and the cruder matter of the alluvial formations near the surface of the earth, and sometimes mineral waters, have to be passed, before the purer fluid can be reached, which comes from the deep strata, peculiar expedients are resorted to by the well-excavator, to prevent these waters from becoming mingled with the purer, and the small perforation from being choked or filled with rubbish. For this purpose, *tubing* is the most appropriate.

The principle upon which the water ascends in the Artesian wells is, we believe, not accounted for by Natural Philosophy, as generally taught in the schools. The principle there inculcated is that of

hydrostatic pressure, by superincumbent water higher than the fountain, by which the water is forced up through the orifices naturally existing, or thus artificially made. The old and popular maxim that "the stream cannot rise higher than the fountain," seems to be here contradicted, and to meet with an important exception.

This pressure, by which the water is forced up in the Artesian well, can not be *hydrostatic*, as we have said, as the earth has to be penetrated several hundred feet, far below this superincumbent hydrostatic pressure existing near the surface. It must be produced by some other cause; perhaps by an internal pressure outward from the interior parts of the earth, occasioned by powerfully elastic gases, or the central fires with which the earth is filled in conjunction with these; and which great pressure outward is necessary to prevent this thin shell of earth upon which we exist from *collapsing* and falling in, by the force of the attraction of gravity constantly operating upon it.

The force of that attraction constantly decreasing as you descend into the earth from the influence of the attraction of the parts above, and that of water, too, decreasing, the specific gravity of which is only one fourth of that of earth; its comparative levity being thus increased, adding to the attraction of the parts above operating upon it, water would be disposed to rise spontaneously to or near the surface.

It is also the opinion of some, that it is the operation of the *centrifugal* force of the earth which is probably the cause. But we are perhaps *theorizing* too much. The *fact* stands as it is, that water can thus be made to rise and flow from the surface of the earth almost anywhere, from the depth of several hundred feet. And it is probably on this principle, whatever may be the *cause* of it, that we can account for the existence of springs on small islands, in the bosom of the ocean, as at St. Helena, and on mountainous elevations, where it seems impossible for any superincumbent or subjacent hydrostatic pressure to exist above the fountain. And it is probable that there is occasionally a natural spring to be found, in all countries, in which the water rises on this principle.

All the "fountains of the great deep," mentioned in the Bible as being "broken

up" at the Deluge, were doubtless of this character; the water in them being forced up and out by the internal pressure of the great mass of "central waters," with which the earth was then filled, the decreasing of the force of gravity and the centrifugal force of the earth aiding in forcing them up and out.

The advantages of Artesian wells, to hygiene, and to agricultural and manufacturing interests, are very obvious. Water of greater purity can be obtained by them than in any other way, as the immense depth from which it generally comes prevents impurities from contact with alluvial beds and mineral strata. The supply never varies, but is constantly the same; and is not affected by changes of weather. And what is most important of all, an abundant supply of pure flowing water can be obtained anywhere.

A spring may be made to issue at any point, and in any location—an almost incalculable advantage in neighbourhoods and situations destitute of water. The only objection, and principle obstacle to making them, is the *expense* that has to be incurred. But this will be greatly lessened if not already done, by improved and expeditious methods of boring, and the use of steam, and other labour-saving machinery.

As the heat of the earth increases as it is penetrated downward, by going sufficiently deep, water of any suitable temperature for bathing may be obtained; and the trouble and expense of heating it saved. And as the water may be made to flow out at any elevation, a constant supply can thus be obtained at as many points as may be desirable on a farm, to irrigate the adjacent fields, however elevated they may be, and also of suitable temperature; and the effects of drought thus obviated.

A sufficient supply of water for steam machinery may thus be obtained in any desirable location; and by uniting several streams at sufficient elevation, plenty of water for hydraulic purposes may be had and for moving any kind of machinery.

GRIEF.—Grief never sleeps; it watches continually, like a jealous husband. All the world groans under its sway, and it fears that, by sleeping, its clutch will be come loosened, and its prey then escape



# POPULAR ASTRONOMY.

## LETTER XIII.

### MOON'S ORBIT.—HER IRREGULARITIES.

"Some say the zodiac constellations  
Have long since left their antique stations,  
Above a sign, and prove the same  
In Taurus now, once in the Ram;  
That in twelve hundred years and odd,  
The sun has left his ancient road,  
And nearer to the earth is come,  
'Bove fifty thousand miles from home."—*Hudibras*.

WE have thus far contemplated the revolution of the moon around the earth as though the earth were at rest. But in order to have just ideas respecting the moon's motions, we must recollect that the moon likewise revolves along with the earth around the sun. It is sometimes said that the earth *carries* the moon along with her, in her annual revolution. This language may convey an erroneous idea; for the moon, as well as the earth, revolves around the sun under the influence of two forces, which are independent of the earth, and would continue her motion around the sun, were the earth removed out of the way. Indeed, the moon is attracted towards the sun two and one fifth times more than towards the earth, and would abandon the earth, were not the latter also carried along with her by the same forces. So far as the sun acts equally on both bodies, the motion with respect to each other would not be disturbed. Because the gravity of the moon towards the sun is found to be greater, at the conjunction, than her gravity towards the earth, some have apprehended that, if the doctrine of universal gravitation is true, the moon ought necessarily to abandon the earth. In order to understand the reason why it does not do this, we must reflect, that, when a body is revolving in its orbit under the influence of the projectile force and gravity, whatever diminishes the force of gravity, while that of projection remains the same, causes the body to approach nearer to the tangent of her orbit, and of course to recede from the centre; and whatever increases the amount of gravity, carries the body towards the centre. Thus, in Fig. 32, page 129, if, with a certain force of projection acting in the direction A B, and of attraction, in the direction A C, the attraction which caused a body to move in the line A D were diminished, it would move nearer to the tangent, as in A E, or A F. Now, when the moon is in conjunction, her gravity towards the earth acts in opposition to that towards the sun, (see Fig. 37, page 159), while her velocity remains too great to carry her with what force remains, in a circle about the sun, and she therefore recedes from the sun, and commences her revolution around the earth. On arriving at the opposition, the gravity of the earth conspires with that of the sun, and the moon's projectile force being less than that required to make her revolve in a circular orbit, when attracted towards the sun by the sum of these forces, she accordingly begins to approach the sun, and descends again to the conjunction.

The attraction of the sun, however, being everywhere greater than that of the earth, the actual path of the moon around the sun is everywhere concave towards the latter. Still, the elliptical path of the moon around the earth is to be conceived of, in the same way as though both bodies were at rest with respect to the sun. Thus, while a steam-boat is passing *swiftly* around an island, and a man is walking *slowly* around a post in the cabin, the line which he describes in space between the forward motion of the boat and his circular motion around the post, may be everywhere concave towards the island, while his path around the post will still be the same as though both were at rest. A nail in the rim of a coach-wheel will turn around the axis of the wheel, when the coach has a forward motion, in the same manner as when the coach is at rest, although the line actually described by the nail will be the resultant of both motions, and very different from either.

We have hitherto regarded the moon as describing a great circle on the face of the sky, such being the visible orbit, as seen by projection. But, on a more exact investigation, it is found that her orbit is not a circle, and that her motions are subject to very numerous irregularities. These will be best understood in connection with the causes on which they depend. The law of universal gravitation has been applied with wonderful success to their development, and its results have conspired with those of long-continued observation, to furnish the means of ascertaining with great exactness, the place of the moon in the heavens, at any given instant of time, past or future, and thus to enable astronomers to determine longitudes, to calculate eclipses, and to solve other problems of the highest interest. The whole number of irregularities to which the moon is subject is not less than sixty, but the greater part are so small as to be hardly deserving of attention; but as many as thirty require to be estimated and allowed for, before we can ascertain the exact place of the moon at any given time. You will be able to understand something of the cause of these irregularities, if you first gain a distinct idea of the mutual actions of the sun, the moon, and the earth. The irregularities in the moon's motions are due chiefly to the disturbing influence of the sun, which operates in two ways; first, by acting unequally on the earth and moon; and secondly, by acting obliquely on the moon, on account of the inclination of her orbit to the ecliptic. If the sun acted equally on the earth and moon, and always in parallel lines, this action would serve only to restrain them in their annual motions around the sun, and would not affect their actions on each other, or their motions about their common centre of gravity. In that case, if they were allowed to fall towards the sun, they would fall equally, and their respective situations would not be affected by their descending equally towards it. But, because the moon is nearer the sun in one half of her orbit than the earth is, and in the other half of her orbit is at a greater distance than the earth from the sun, while the power of gravity is always greater at a less distance; it follows, that in one half of her orbit the moon is more attracted than the earth towards the sun, and, in the other half, less attracted than the earth.

To see the effects of this process, let us suppose that the projectile motions of the earth and moon were destroyed, and that they were allowed to fall freely towards the sun. (See Fig. 37, page 159). If the moon was in conjunction with the sun, or in that part of her orbit which is nearest to him, the moon would be more attracted than the earth, and fall with greater velocity towards the sun; so that the distance of the moon from the earth would be increased by the fall. If the moon was in opposition, or in the part of her orbit which is furthest from the sun, she would be less attracted than the earth by the sun, and would fall with a less velocity, and be left behind: so that the distance of the moon from the earth would be increased in this case also. If the moon was in one of the quarters, then the earth and the moon being both attracted towards the centre of the sun, they would both descend directly towards that centre, and, by approaching it, they would necessarily at the same time approach each other, and in this case their distance from each other would be diminished. Now, whenever the action of the sun would increase their distance, if they were allowed to fall towards the sun, then the sun's action, by endeavouring to separate them, diminishes their gravity to each other; whenever the sun's action would diminish the distance, then it increases their mutual gravitation. Hence, in the conjunction and opposition, their gravity towards each other is diminished by the action of the sun, while in the quadratures it is increased. But it must be remembered, that it is not the total action of the sun on them that disturbs their motions, but only that part of it which tends at one time to separate them, and at another time to bring them nearer together. The other and far greater part has no other effect than to retain them in their annual course around the sun.

The cause of the lunar irregularities was first investigated by Sir Isaac Newton, in conformity with his doctrine of universal gravitation, and the explanation was first published in the "Principia;" but, as it was given in a mathematical dress, there were at that age very few persons capable of reading or understanding it. Several



eminent individuals, therefore, undertook to give a popular explanation of these difficult points. Among Newton's contemporaries, the best commentator was M'Laurin, a Scottish astronomer, who published a large work entitled, "M'Laurin's Account of Sir Isaac Newton's Discoveries." No writer of his own day, and, in my opinion, no later commentator, has equalled M'Laurin in reducing to common apprehension the leading principles of the doctrine of gravitation; and the explanation it affords of the motions of the heavenly bodies. To this writer I am indebted for the preceding easy explanation of the irregularities of the moon's motions, as well as for several other illustrations of the same sublime doctrine.

The figure of the moon's orbit is an ellipse. We have before seen, that the earth's orbit around the sun is of the same figure; and we shall hereafter see this to be true of all the planetary orbits. The path of the earth, however, departs very little from a circle; that of the moon differs materially from a circle, being considerably longer one way than the other. Were the orbit a circle, having the earth in the centre, then the radius vector, or line drawn from the centre of the moon to the centre of the earth, would always be of the same length; but it is found that the length of the radius vector is only fifty-six times the radius of the earth when the moon is nearest to us, while it is sixty-four times that radius when the moon is furthest from us. The point in the moon's orbit nearest the earth is called her *perigee*; the point furthest from the earth, her *apogee*. We always know when the moon is at one of these points, by her apparent diameter or apparent velocity; for, when at the perigee, her diameter is greater than at any time, and her motion most rapid; and, on the other hand, her diameter is least, and her motion slowest, when she is at her apogee.

The moon's nodes constantly shift their positions in the ecliptic, from east to west, at the rate of about nineteen and a half degrees every year, returning to the same points once in eighteen and a half years. In order to understand what is meant by this backward motion of the nodes, you must have very distinctly in mind the meaning of the terms themselves; and if, at any time, you should be at a loss about the signification of any word that is used in expressing an astronomical proposition, I would advise you to turn back to the previous definition of that term, and revive its meaning clearly in the mind, before you proceed any further. In the present case, you will recollect that the moon's nodes are the two points where her orbit cuts the plane of the ecliptic. Suppose the great circle of the ecliptic marked out on the face of the sky in a distinct line, and let us observe, at any given time the exact moment when the moon crosses this line, which we will suppose to be close to a certain star; then, on its next return to that part of the heavens we shall find that it crosses the ecliptic sensibly to the westward of that star, and so on, further and further to the westward, every time it crosses the ecliptic at either node. This fact is expressed by saying that *the nodes retrograde on the ecliptic*; since any motion from east to west, being contrary to the order of the signs, is called retrograde. The line which joins these two points, or the line of the nodes, is also said to have a retrograde motion, or to revolve from east to west once in eighteen and a half years.

The *line of the apsides* of the moon's orbit revolves from west to east, through her whole course, in about nine years. You will recollect that the apsides of an elliptical orbit are the two extremities of the longer axis of the ellipse; corresponding to the perihelion and aphelion of bodies revolving about the sun, or to the perigee and apogee of a body revolving about the earth. If in any revolution of the moon, we should accurately mark the place in the heavens where the moon is nearest the earth (which may be known by the moon's apparent diameter being then greatest), we should find that, at the next revolution, it would come to its perigee a little further eastward than before, and so on at every revolution, until, after nine years, it would come to its perigee nearly at the same point as at first. This fact is expressed by saying that the perigee, and of course the apogee, revolves,—and that the line which joins these two points or the line of the apsides, also revolves.

These are only a few of the irregularities that attend the motions of the moon. These and a few others were first discovered by actual observation, and have been long

known; but a far greater number of lunar irregularities have been made known by following out all the consequences of the law of universal gravitation.

The moon may be regarded as a body endeavouring to make its way around the earth, but as subject to be continually impeded, or diverted from its main course, by the action of the sun and of the earth; sometimes acting in concert and sometimes in opposition to each other. Now, by exactly estimating the amount of these respective forces, and ascertaining their resultant or combined effect, in any given case, the direction and velocity of the moon's motion may be accurately determined. But to do this has required the highest powers of the human mind, aided by all the wonderful resources of mathematics. Yet, so consistent is truth with itself, that, where some minute inequality in the moon's motions is developed at the end of a long and intricate mathematical process, it invariably happens that, on pointing the telescope to the moon and watching its progress through the skies, we may actually see her commit the same irregularities, unless (as is the case with many of them) they are too minute to be matters of observation, being beyond the power of our vision even when aided by the best telescopes. But the truth of the law of gravitation, and of the results it gives, when followed out by a chain of mathematical reasoning, is fully confirmed, even in these minutest matters, by the fact that the moon's place in the heavens, when thus determined, always corresponds, with wonderful exactness, to the place which she is actually observed to occupy at that time.

The mind that was first able to elicit from the operations of Nature the law of universal gravitation, and afterwards to apply it to the complete explanation of all the irregular wanderings of the moon, must have given evidence of intellectual powers far elevated above those of the majority of the human race. We need not wonder, therefore, that such homage is now paid to the genius of Newton,—an admiration which has been continually increasing, as new discoveries have been made by tracing out new consequences of the law of universal gravitation.

The chief object of astronomical *tables* is to give the amount of all the irregularities that attend the motions of the heavenly bodies, by estimating the separate value of each, under all the different circumstances in which a body can be placed. Thus, with respect to the moon, before we can determine accurately the distance of the moon from the vernal equinox, that is, her longitude at any given moment, we must be able to make exact allowances for all her irregularities which would affect her longitude. These are in all no less than sixty, though most of them are so exceedingly minute, that it is not common to take into the account more than twenty-eight or thirty. The values of these are all given in the lunar tables; and in finding the moon's place, at any given time, we proceed as follows:—We first find what her place would be on the supposition that she moves uniformly in a circle. This gives her *mean* place. We next apply the various corrections for her irregular motions; that is, we apply the *equations*, subtracting some and adding others, and thus we find her *true* place.

The Astronomical Tables have been carried to such an astonishing degree of accuracy, that it is said, by the highest authority, that an astronomer could now predict for a thousand years to come, the precise moment of the passage of any one of the stars over the meridian wire of the telescope of his transit instrument, with such a degree of accuracy, that the error would not be so great as to remove the object through an angular space corresponding to the semi-diameter of the finest wire that could be made; and a body which, by the tables, ought to appear in the transit-instrument in the middle of that wire, would in no case be removed to its outer edge. The astronomer, the mathematician, and the artist, have united their powers to produce this great result. The astronomer has collected the data, by long-continued and most accurate observations on the actual motions of the heavenly bodies from night to night, and from year to year; the mathematician has taken these data, and applied to them the boundless resources of geometry and the calculus; and, finally, the instrument-maker has furnished the means, not only of verifying these conclusions, but of discovering new truths, as the foundation of future reasonings.

Since the points where the moon crosses the ecliptic, or the moon's nodes, constantly



shift their positions about nineteen and a half degrees to the westward every year, the sun, in his annual progress in the ecliptic, will go from the node round to the same node again in less time than a year, since the node goes to meet him nineteen and a half degrees to the west of the point where they met before. It would have taken the sun about nineteen days to have passed over this arc; and, consequently, the interval between two successive conjunctions between the sun and the moon's node is about nineteen days shorter than the solar year of three hundred and sixty-five days; that is, it is about three hundred and forty-six days; or, more exactly, it is 346·619851 days. The time from one new moon to another is 29·5305887 days. Now, nineteen of the former periods are almost exactly equal to two hundred and twenty-three of the latter :

For  $346·619851 \times 19 = 6585·78$  days = 18 years 10 days.

And  $29·5305887 \times 223 = 6585·32$  „ „ „

Hence, if the sun and moon were to leave the moon's node together, after the sun had been round to the same node nineteen times, the moon would have made very nearly two hundred and twenty-three conjunctions with the sun. If, therefore, she was in conjunction with the sun at the beginning of this period, she would be in conjunction again at the end of it; and all things relating to the sun, the moon, and the node, would be restored to the same relative situation as before, and the sun and moon would start again, to repeat the same phenomena, arising out of these relations, as occurred in the preceding period, and in the same order. Now, when the sun and moon meet at the moon's node, an eclipse of the sun happens; and during the entire period of eighteen and a half years eclipses will happen, nearly in the same manner as they did at corresponding times in the preceding period. Thus, if there was a great eclipse of the sun on the fifth year of one of these periods, a similar eclipse (usually differing somewhat in magnitude) might be expected on the fifth year of the next period. Hence this period, consisting of about eighteen years and ten days, under the name of the *Saros*, was used by the Chaldeans, and other ancient nations, in predicting eclipses. It was probably by this means that Thales, a Grecian astronomer who flourished six hundred years before the Christian era, predicted an eclipse of the sun. Herodotus, the old historian of Greece, relates that the day was suddenly changed into night, and that Thales of Miletus had foretold that a great eclipse was to happen *this year*. It was therefore, at that age, considered as a distinguished feat to predict even the year in which an eclipse was to happen. This eclipse is memorable in ancient history, from its having terminated the war between the Lydians and the Medes, both parties being smitten with such indications of the wrath of the gods.

The *Metonic Cycle* has sometimes been confounded with the *Saros*, but it is not the same with it, nor was the period used, like the *Saros*, for foretelling eclipses, but for ascertaining the *age* of the moon at any given period. It consisted of nineteen tropical years, during which time there are exactly two hundred and thirty-five new moons; so that, at the end of this period, the new moons will recur at seasons of the year corresponding exactly to those of the preceding cycle. If, for example, a new moon fell at the time of the vernal equinox, in one cycle, nineteen years afterwards it would occur again at the same equinox; or, if it had happened ten days after the equinox, in one cycle, it would also happen ten days after the equinox, nineteen years afterwards. By registering, therefore, the exact days of any cycle at which the new or full moons occurred, such a calendar would show on what days these events would occur in any other cycle; and, since the regulation of games, feasts, and fasts has been made very extensively both in ancient and modern times, according to new or full moons, such a calendar becomes very convenient for finding the day on which the new or full moon required takes place. Suppose, for example, it were decreed, that a festival should be held on the day of the first full moon after the Vernal equinox. Then, to find on what day that would happen, in any given year, we have only to see what year it is of the lunar cycle; for the day will be the same as it was in the corresponding year of the calendar which records all the full moons of the cycle for each year, and the respective days on which they happen.

The Athenians adopted the metonic cycle four hundred and thirty-three years before the Christian era, for the regulation of their calendars, and had it inscribed in letters of gold on the walls of the Temple of Minerva. Hence the term *golden number*, still found in our almanacs, which denotes the year of the lunar cycle. Thus, ten is the golden number for 1852, being the tenth year of the lunar cycle.

The inequalities of the moon's motions are divided into periodical and secular. *Periodical* inequalities are those which are completed in comparatively short periods. *Secular* inequalities are those which are completed only in very long periods, such as centuries or ages. Hence the corresponding terms *periodical equations* and *secular equations*. As an example of a secular inequality, we may mention the acceleration of the *moon's mean motion*. It is discovered that the moon actually revolves around the earth in a less period now than she did in ancient times. The difference, however, is exceedingly small, being only about ten seconds in a century. In a lunar eclipse, the moon's longitude differs from that of the sun, at the middle of the eclipse, by exactly one hundred and eighty degrees; and, since the sun's longitude at any given time of the year is known, if we can learn the day and hour when an eclipse occurred at any period of the world, we of course know the longitude of the sun and moon at that period. Now, in the year 721 before the Christian era, Ptolemy records a lunar eclipse to have happened, and to have been observed by the Chaldeans. The moon's longitude, therefore, for that time is known; and as we know the mean motions of the moon, at present starting from that epoch, and computing, as may easily be done, the place which the moon ought to occupy at present, at any given time, she is found to be actually nearly a degree and a half in advance of that place. Moreover, the same conclusion is derived from a comparison of the Chaldean observations with those made by an Arabian astronomer of the tenth century.

This phenomenon at first led astronomers to apprehend that the moon encountered a resisting medium, which, by destroying at every revolution a small portion of her projectile force, would have the effect to bring her nearer and nearer to the earth, and thus to augment her velocity. But, in 1786, La Place demonstrated that this acceleration is one of the legitimate effects of the sun's disturbing force, and is so connected with changes in the eccentricity of the earth's orbit, that the moon will continue to be accelerated while that eccentricity diminishes; but when the eccentricity has reached its minimum, or lowest point (as it will do after many ages), and begins to increase, then the moon's motions will begin to be retarded, and thus her mean motions will oscillate for ever about a mean value.

## LETTER XIV.

### ECLIPSES.

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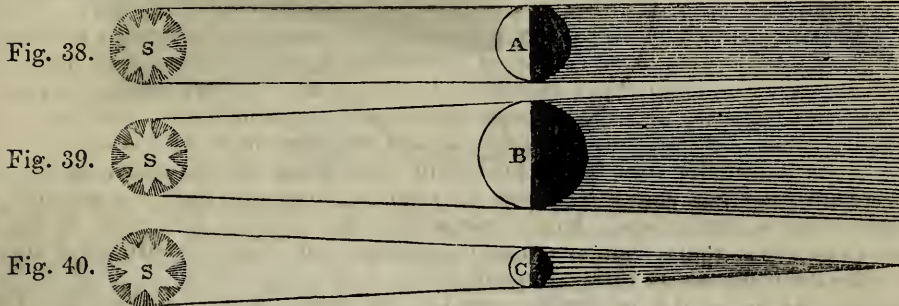
“As when the sun, new risen,  
Looks through the horizontal misty air,  
Shorn of his beams, or from behind the moon,  
In dim eclipse, disastrous twilight sheds  
On half the nations, and with fear of change  
Perplexes monarchs: darken'd so, yet shone,  
Above them all, the Archangel.”—*Milton*.

HAVING now learned various particulars respecting the earth, the sun, and the moon, you are prepared to understand the explanation of solar and lunar eclipses, which have in all ages excited a high degree of interest. Indeed, what is more admirable, than that astronomers should be able to tell us, years beforehand, the exact instant of the commencement and termination of an eclipse, and describe all the attendant circumstances with the greatest fidelity? You have doubtless, my dear friend, participated in this admiration, and felt a strong desire to learn how it is that astronomers are able to look so far into futurity. I will endeavour, in this Letter, to explain to you the leading principles of the calculation of eclipses, with as much plainness as possible.



An *eclipse of the moon* happens when the moon, in its revolution round the earth, falls into the earth's shadow. An *eclipse of the sun* happens when the moon, coming between the earth and the sun, covers either a part or the whole of the solar disc.

The earth and the moon being both opaque, globular bodies, exposed to the sun's light, they cast shadows opposite to the sun, like any other bodies on which the sun shines. Were the sun of the same size with the earth and the moon, then the lines drawn touching the surface of the sun and the surface of the earth or moon (which lines form the boundaries of the shadow) would be parallel to each other, and the shadow would be a cylinder infinite in length; and were the sun less than the earth or the moon, the shadow would be an increasing cone, its narrower end resting on the earth; but as the sun is vastly greater than either of these bodies, the shadow of each is a cone whose base rests on the body itself, and which comes to a point, or vertex, at a certain distance behind the body. These several cases are represented in the following diagrams, Figs. 38, 39, 40.



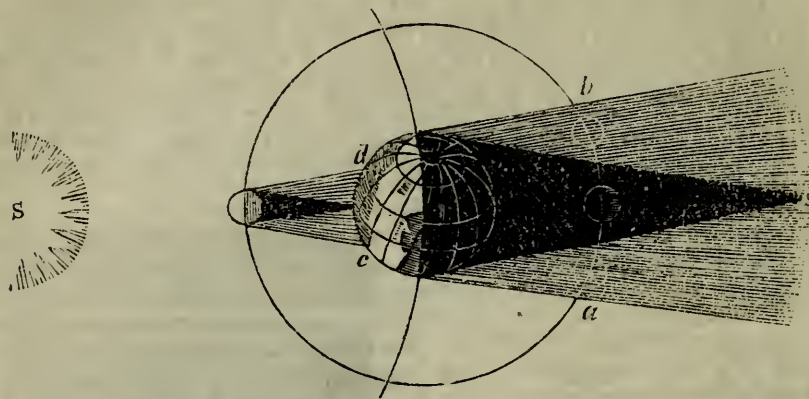
It is found, by calculation, that the length of the moon's shadow, on an average, is just about sufficient to reach to the earth; but the moon is sometimes further from the earth than at others; and when she is nearer than usual, the shadow reaches considerably beyond the surface of the earth. Also, the moon, as well as the earth, is at different distances from the sun at different times, and its shadow is longest when it is furthest from the sun. Now, when both these circumstances conspire, that is, when the moon is in her perigee and along with the earth in her aphelion, her shadow extends nearly fifteen thousand miles beyond the centre of the earth, and covers a space on the surface one hundred and seventy miles broad. The earth's shadow is nearly a million of miles in length, and consequently more than three and a half times as long as the distance of the earth from the moon; and it is also, at the distance of the moon, three times as broad as the moon itself.

An eclipse of the sun can take place only at new moon, when the sun and moon meet in the same part of the heavens, for then only can the moon come between us and the sun; and an eclipse of the moon can occur only when the sun and moon are in opposite parts of the heavens, or at full moon; for then only can the moon fall into the shadow of the earth.

The nature of eclipses will be clearly understood from the following representation. The diagram, Fig. 41, exhibits the relative position of the sun, the earth, and the moon, both in a solar and in a lunar eclipse. Here, the moon is first represented, while revolving round the earth, as passing between the earth and the sun, and casting its shadow on the earth. As the moon is here supposed to be at her average distance from the earth, the shadow but just reaches the earth's surface. Were the moon (as is sometimes the case) nearer the earth, her shadow would not terminate in a point, as is represented in the figure, but at a greater or less distance nearer the base of the cone, so as to cover a considerable space, which, as I have already mentioned, sometimes extends to one hundred and seventy miles in breadth, but is commonly much less than this. On the other side of the earth, the moon is represented as traversing the earth's shadow, as is the case in a lunar eclipse. As the moon is sometimes nearer

the earth and sometimes further off, it is evident that it will traverse the shadow at a broader or a narrower part, accordingly. The figure, however, represents the moon as passing the shadow further from the earth than is ever actually the case, since the distance from the earth is never so much as one-third of the whole length of the shadow.

Fig. 41.



It is evident from the figure, that if a spectator were situated where the moon's shadow strikes the earth, the moon would cut off from him the view of the sun, or the sun would be totally eclipsed. Or, if he were within a certain distance of the shadow on either side, the moon would be partly between him and the sun, and would intercept from him more or less of the sun's light, according as he was nearer to the shadow or further from it. If he were at *c* or *d*, he would just see the moon entering upon the sun's disc; if he were nearer the shadow than either of these points, he would have a portion of this light cut off from his view, and more, in proportion as he drew nearer the shadow; and the moment he entered the shadow, he would lose sight of the sun. To all places between *a* or *b* and the shadow, the sun would cast a partial shadow of the moon, growing deeper and deeper, as it approached the true shadow. This partial shadow is called the moon's *penumbra*. In like manner, as the moon approaches the earth's shadow, in a lunar eclipse, as soon as she arrives at *a*, the earth begins to intercept from her a portion of the sun's light, or she falls in the earth's penumbra. She continues to lose more and more of the sun's light, as she draws near to the shadow, and hence her disc becomes gradually obscured, until it enters the shadow, when the sun's light is entirely lost.

As the sun and earth are both situated in the plane of the ecliptic, if the moon also revolved around the earth in this plane, we should have a solar eclipse at every new moon, and a lunar eclipse at every full moon; for, in the former case, the moon would come directly between us and the sun; and in the latter case, the earth would come directly between the sun and the moon. But the moon is inclined to the ecliptic about five degrees, and the centre of the moon may be all this distance from the centre of the sun at new moon, and the same distance from the centre of the earth's shadow at full moon. It is true, the moon extends across her path, one-half her breadth lying on each side of it, and the sun likewise reaches from the ecliptic a distance equal to half his breadth. But these luminaries together make but little more than a degree, and consequently, their two semi-diameters would occupy only about half a degree of the five degrees from one orbit to the other where they are furthest apart. Also, the earth's shadow, where the moon crosses it, extends from the ecliptic less than three-fourths of a degree, so that the semi-diameter of the moon and of the earth's shadow would together reach but little way across the space that may, in certain cases, separate the two luminaries from each other when they are in opposition. Thus, suppose we could take hold of the circle in the figure that represents the moon's



orbit (Fig. 41, page 188), and lift the moon up five degrees above the plane of the paper, it is evident that the moon, as seen from the earth, would appear in the heavens five degrees above the sun, and of course would cut off none of his light; and it is also plain that the moon, at the full, would pass the shadow of the earth five degrees below it, and would suffer no eclipse. But in the course of the sun's apparent revolution round the earth once a year, he is successively in every part of the ecliptic; consequently, the conjunctions and oppositions of the sun and moon may occur at any part of the ecliptic, and of course at the two points where the moon's orbit crosses the ecliptic,—that is, at the nodes; for the sun must necessarily come to each of these nodes once a year. If, then, the moon overtakes the sun just as she is crossing his path, she will hide more or less of his disc from us. Since, also, the earth's shadow is always directly opposite to the sun, if the sun is at one of the nodes, the shadow must extend in the direction of the other node, so as to lie directly across the moon's path; and if the moon overtakes it there, she will pass through it, and be eclipsed. Thus, in Fig. 42, let B N represent the sun's path, and A N, the moon's,—

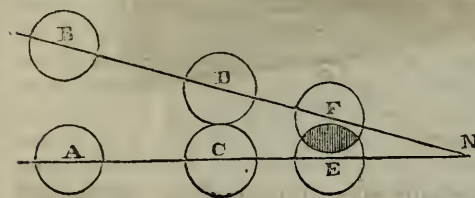


Fig. 42.

N being the place of the node; then it is evident, that if the two luminaries at new moon be so far from the node, that the distances between their centres is greater than their semi-diameters, no eclipse can happen; but if that distance is less than this sum, as at E, F, then an eclipse will take place; but if the position be as at C, D, the two bodies will just touch one another. If A denotes the earth's shadow,

instead of the sun, the same illustration will apply to an eclipse of the moon.

Since bodies are defined to be in conjunction when they are in the *same* part of the heavens, and to be in opposition when they are in *opposite* parts of the heavens, it may not appear how the sun and moon can be in conjunction, as at A and B, when they are still at some distance from each other. But it must be recollected that bodies are in conjunction when they have the same longitude; in which case they are situated in the same great circle perpendicular to the ecliptic,—that is, in the same secondary to the ecliptic. One of these bodies may be much further from the ecliptic than the other; still, if the same secondary to the ecliptic passes through them both, they will be in conjunction or opposition.

In a total eclipse of the moon, its disc is still visible, shining with a dull, red light. This light cannot be derived directly from the sun, since the view of the sun is completely hidden from the moon; nor by reflection from the earth, since the illuminated side of the earth is wholly turned from the moon; but it is owing to refraction from the earth's atmosphere, by which a few scattered rays of the sun are bent round into the earth's shadow and conveyed to the moon, sufficient in number to afford the feeble light in question.

It is impossible fully to understand the *method of calculating eclipses*, without a knowledge of trigonometry; still it is not difficult to form some general notion of the process. It may be readily conceived that, by long-continued observations on the sun and moon, the laws of their revolution may be so well understood, that the exact places which they will occupy in the heavens at any future times may be foreseen and laid down in tables of the sun and moon's motions; that we may thus ascertain, by inspecting the tables, the instant when these two bodies will be together in the heavens, or be in conjunction, and when they will be one hundred and eighty degrees apart, or in opposition. Moreover, since the exact place of the moon's node among the stars at any particular time is known to astronomers, it cannot be difficult to determine when the new or full moon occurs in the same part of the heavens as that where the node is projected, as seen from the earth. In short, as astronomers can easily determine what will be the relative position of the sun, the moon, and the moon's nodes, for any given time, they can tell when these luminaries

will meet so near the node as to produce an eclipse of the sun, or when they will be in opposition so near the node as to produce an eclipse of the moon.

A little reflection will enable you to form a clear idea of the situation of the sun, the moon, and the earth, at the time of a solar eclipse. First, suppose the conjunction to take place at the node; that is, imagine the moon to come *directly* between the earth and the sun,—as she will of course do, if she comes between the earth and the sun the moment she is crossing the ecliptic; for then the three bodies will all lie in one and the same straight line. But when the moon is in the ecliptic, her shadow, or at least the axis, or central line, of the shadow, must coincide with the line that joins the centres of the sun and earth, and reach along the plane of the ecliptic towards the earth. The moon's shadow, at her average distance from the earth, is just about long enough to reach the surface of the earth; but when the moon, at the new, is in her apogee, or at her greatest distance from the earth, the shadow is not long enough to reach the earth. On the contrary when the moon is nearer to us than her average distance, her shadow is long enough to reach beyond the earth, extending, when the moon is in her perigee, more than fourteen thousand miles beyond the centre of the earth. Now, as during the eclipse the moon moves nearly in the plane of the ecliptic, her shadow which accompanies her must also move nearly in the same plane, and must therefore traverse the earth across its central regions, along the terrestrial ecliptic, since this is nothing more than the intersection of the plane of the celestial ecliptic with the earth's surface. The motion of the earth, too, on its axis, in the same direction, will carry a place along with the shadow, though with a less velocity by more than one half; so that the actual velocity of the shadow, in respect to places over which it passes on the earth, will only equal the difference between its own rate and that of the places, as they are carried forward in the diurnal revolution, as before stated.

We have thus far supposed that the moon comes to her conjunction precisely at the node, or at the moment when she is crossing the ecliptic. But, secondly, suppose she is on the north side of the ecliptic at the time of conjunction, and moving towards her descending node and that the conjunction takes place as far from the node as an eclipse can happen. The shadow will not fall in the plane of the ecliptic, but a little northward of it, so as just to graze the earth near the pole of the ecliptic. The nearer the conjunction comes to the node, the further the shadow will fall from the pole towards the equatorial regions.

In a solar eclipse, the shadow of the moon travels over a portion of the earth, as the shadow of a small cloud, seen from an eminence in a clear day, rides along over hills and plains. Let us imagine ourselves standing on the moon; then we shall see the earth partially eclipsed by the moon's shadow, in the same manner as we now see the moon eclipsed by the shadow of the earth; and we might calculate the various circumstances of the eclipse,—its commencement, duration, and quantity,—in the same manner as we calculate these elements in an eclipse of the moon, as seen from the earth. But although the general characters of a solar eclipse might be investigated on these principles, so far as respects the earth at large, yet, as the appearances of the same eclipse of the sun are very different at different places on the earth's surface, it is necessary to calculate its peculiar aspects for each place separately; a circumstance which makes the calculation of a solar eclipse much more complicated and tedious than that of an eclipse of the moon. The moon, when she enters the shadow of the earth, is deprived of the light of the part immersed, and the effect upon its appearance is the same as though that part were painted black, in which case it would be black alike to all places where the moon was above the horizon. But it is not so with a solar eclipse. We do not see this by the shadow cast on the earth, as we should do, if we stood on the moon, but by the interposition of the moon between us and the sun; and the sun may be hidden from one observer, while he is in full view of another only a few miles distant. Thus, a small insulated cloud sailing in a clear sky will, for a few moments, hide the sun from us, and from a certain space near us while all the region around is illuminated. But although the analogy



between the motions of the shadow of a small cloud and of the moon in a solar eclipse holds good in many particulars, yet the velocity of the lunar shadow is far greater than that of the cloud, being no less than two thousand two hundred and eighty miles per hour.

The moon's shadow can never cover a space on the earth more than one hundred and seventy miles broad, and the space actually covered commonly falls much short of that. The portion of the earth's surface ever covered by the moon's penumbra is about four thousand three hundred and ninety-three miles.

The apparent diameter of the moon varies materially at different times, being greatest when the moon is nearest to us, and least when she is furthest off; while the sun's apparent dimensions remain nearly the same. When the moon is at her average distance from the earth, she is just about large enough to cover the sun's disc; consequently, if, in a central eclipse of the sun, the moon is at her mean distance, she covers the sun but for an instant, producing only a momentary eclipse. If she is nearer than her average distance, then the eclipse may continue total some time, though never more than eight minutes, and seldom so long as that; but if she is further off than usual, or towards her apogee, then she is not large enough

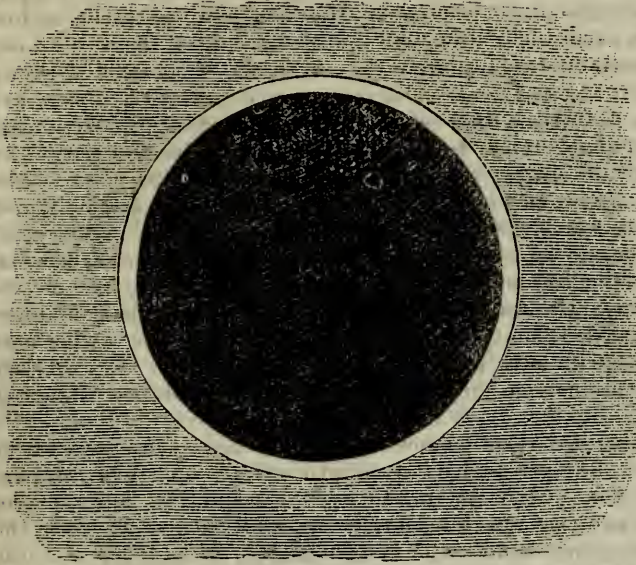


Fig. 43.

to cover the whole solar disc, but we see a ring of the sun encircling the moon, constituting an *annular eclipse*, as seen in Fig. 43. Even the elevation of the moon above the horizon will sometimes sensibly affect the dimensions of the eclipse. You will recollect that the moon is nearer to us when on the meridian, than when in the horizon by nearly four thousand miles, or by nearly the radius of the earth; and consequently, her apparent diameter is largest when on the meridian. The difference is so considerable, that the same eclipse will appear total to a spectator who views it near his meridian, while, at the same moment, it appears annular to one who has the moon near his horizon. An annular eclipse may last, at most, twelve minutes and twenty-four seconds.

Eclipses of the sun are more frequent than those of the moon. Yet lunar eclipses being visible to every part of the terrestrial hemisphere opposite to the sun, while those of the sun are visible only to a small portion of the hemisphere on which the moon's shadow falls, it happens that, for any particular place on the earth, lunar eclipses are more frequently visible than solar. In any year, the number of eclipses of both luminaries cannot be less than two nor more than seven: the most usual number is four, and it is very rare to have more than six. A total eclipse of the moon frequently happens at the next full moon after an eclipse of the sun. For since, in a solar eclipse, the sun is at or near one of the moon's nodes,—that is, is projected to the place in the sky where the moon crosses the ecliptic,—the earth's shadow, which is of course directly opposite to the sun, must be at or near the other node, and may not have passed too far from the node before the moon comes round to the opposition and overtakes it. In total eclipses of the sun, there has sometimes been observed a

remarkable radiation of light from the margin of the sun, which is thought to be owing to the zodiacal light, which is of such dimensions as to extend far beyond the solar orb. A striking appearance of this kind was exhibited in the total eclipse of the sun which occurred in June, 1806.

A total eclipse of the sun is one of the most sublime and impressive phenomena of Nature. Among barbarous tribes it is ever contemplated with fear and astonishment, and as strongly indicative of the displeasure of the gods. Two ancient nations, the Lydians and Medes (alluded to before), who were engaged in a bloody war, about six hundred years before Christ, were smitten with such awe, on the appearance of a total eclipse of the sun, just on the eve of a battle, that they threw down their arms, and made peace. When Columbus first discovered America, and was in danger of hostility from the natives, he awed them into submission by telling them that the sun would be darkened on a certain day, in token of the anger of the gods at them, for their treatment of him.

Among cultivated nations, a total eclipse of the sun is recognized, from the exactness with which the time of occurrence and the various appearances answer to the prediction, as affording one of the proudest triumphs of astronomy. By astronomers themselves, it is of course viewed with the highest interest, not only as verifying their calculations, but as contributing to establish, beyond all doubt, the certainty of those grand laws, the truth of which is involved in the result. I had the good fortune to witness the total eclipse of the sun of June, 1806, which was one of the most remarkable on record. To the wondering gaze of childhood it presented a spectacle that can never be forgotten. A bright and beautiful morning inspired universal joy, for the sky was entirely cloudless. Everyone was busily occupied in preparing smoked glass, in readiness for the great sight, which was to be first seen about ten o'clock. A thrill of mingled wonder and delight struck every mind when, at the appointed moment, a little black indentation appeared on the limb of the sun. This gradually expanded, covering more and more of the solar disc, until an increasing gloom was spread over the face of Nature; and when the sun was wholly lost, near mid-day, a feeling of horror pervaded almost every beholder. The darkness was wholly unlike that of twilight or night. A thick curtain, very different from clouds, hung upon the face of the sky, producing a strange and indescribably gloomy appearance, which was reflected from all things on the earth, in hues equally strange and unnatural. Some of the planets, and the largest of the fixed stars, shone out through the gloom, yet with their usual brightness. The temperature of the air rapidly declined, and so sudden a chill came over the earth, that many persons caught severe colds from their exposure. Even the animal tribes exhibited tokens of fear and agitation. Birds, especially, fluttered and flew swiftly about, and domestic fowls went to rest.

Indeed, the word *eclipse* is derived from the Greek word, (*εκλειψις*, *ekleipsis*,) which signifies to fail, to faint or swoon away; since the moon, at the period of her greatest brightness, falling into the shadow of the earth, was imagined by the ancients to sicken and swoon, as if she were going to die. By some very ancient nations she was supposed, at such times, to be in pain; and, in order to relieve her fancied distress, they lifted torches high in the atmosphere, blew horns and trumpets, beat upon brazen vessels, and even, after the eclipse was over, they offered sacrifices to the moon. The opinion also extensively prevailed, that it was in the power of witches, by their spells and charms, not only to darken the moon, but to bring her down from her orbit, and to compel her to shed her baleful influences upon the earth. In solar eclipses, also, especially when total, the sun was supposed to turn away his face in abhorrence of some atrocious crime, that either had been perpetrated or was about to be perpetrated, and to threaten mankind with everlasting night, and the destruction of the world. To such superstitions Milton alludes in the passage which I have taken for the motto of this Letter.

The Chinese, who, from a very high period of antiquity, have been great observers of eclipses, although they did not take much notice of those of the moon, regarded



eclipses of the sun in general as unfortunate, but especially such as occurred on the first day of the year. These were thought to forbode the greatest calamities to the emperor, who on such occasions did not receive the usual compliments of the season. When, from the predictions of their astronomers, an eclipse of the sun was expected, they made great preparation at court for observing it; and as soon as it commenced, a blind man beat a drum, a great concourse assembled, and the mandarins or nobility appeared in state.

(To be continued.)

## QUANTITY OF CIRCULATING BLOOD IN MAN.

EACH cavity of the heart may contain from two to three ounces, of blood. The heart contracts four thousand times in one hour: therefore, there passes through the heart, every hour, eight thousand ounces, or seven hundred pounds of blood. The whole mass of blood in an adult man is about twenty-five or thirty pounds, so that a quantity of blood equal to the whole mass passes through the heart twenty-eight times in an hour, which is about once every two minutes. What an affair must this be in very large animals! It has been said, and with truth, that the aorta of a whale is larger in the bore than the main-pipe of many considerable water-works, and that the water roaring in its passage through the pipe is inferior in impetus and velocity to the blood gushing from a whale's heart. Dr. Hunter, in his account of the dissection of a whale, states that the aorta measured a foot in diameter, and that ten or fifteen gallons of blood are thrown out of the heart at a stroke with an immense velocity through a tube of a foot diameter.

It has been well observed, that we cannot be sufficiently grateful that all our vital motions are involuntary, and independent of our care. We should have enough to do had we to keep our hearts beating, and our stomachs at work. Did these things depend, not to say upon our effort, but even upon our bidding, upon our care and attention, they would leave us leisure for nothing else. Constantly must we have been upon the watch, and constantly in fear: night and day our thoughts must have been devoted to this one object; for the cessation of the action, even for a few seconds, would be fatal: such a constitution would have been incompatible with repose.

The wisdom of the Creator, says a

distinguished anatomist, is in nothing seen more gloriously than in the heart. And how well does it perform its office! An anatomist who understood its structure might say beforehand that it would play; but from the complexity of its mechanism, and the delicacy of many of its parts, he must be apprehensive that it would always be liable to derangement, and that it would soon work itself out. Yet does this wonderful machine go on, night and day, for eighty years together, at the rate of a hundred thousand strokes every twenty four hours, having at every stroke a great resistance to overcome, and it continues this action for this length of time without disorder, and without weariness.

That it should continue this action for this length of time without disorder is wonderful; that it should be capable of continuing it without weariness is still more astonishing. Never, for a single moment, night or day, does it intermit its labour, neither through our waking nor our sleeping hours. On it goes, without intermission, at the rate of a hundred thousand strokes every twenty-four hours; yet it never feels fatigued, it never seems exhausted. Rest would have been incompatible with its functions. While it slept the whole machinery must have stopped, and the animal inevitably perish. It was necessary that it should be made capable of working for ever, without the cessation of a moment — without the least degree of weariness. It is so made; and the power of the Creator in so constructing it can in nothing be exceeded but His wisdom!

THE heart never grows better by age: I fear, rather worse; always harder. A young liar will be an old one; and a young knave will only be a greater knave as he grows older.—*Chesterfield.*

## THE MIRROR OF NATURE.

*(Continued from page 168.)*

It behoves us now to mention, in passing, that some things are to be considered in regard to finding a prize of this sort. There is something tempting and perilous in thus getting rich without trouble. In the eleventh and twelfth centuries many people in Bohemia set to work to wash out of the sand of one of their rivers the gold contained therein. Many of them gained more than could be got then by agriculture and the raising of cattle. But what happened? When the other inhabitants of the country saw that hundreds, and at last thousands, earned more by this easy business than they with their hard labour, many of them, thinking they could do as well as others, left their land untilled. There arose a great scarcity and severe famine in the land. Of what avail was their wealth then, to the most fortunate gold-washers, who in a year's space had procured a pound and more of the noble metal? They could not for hard money purchase bread enough for themselves and their families; many perished of starvation, and the government, in order to prevent the recurrence of similar unhappy consequences, forbade the business of gold-washing under heavy penalties. (M. v. Hagecius in his *Bohemian Chronicle*, translated by Sandel, p. 329.)

And has not that, which then impoverished a little country and its inhabitants, been repeated also on a grand scale in the history of mighty kingdoms? In our days what has poor Spain, what has Portugal kept in actual possession, of all the thousands of hundred weight of gold, which they took from the harmless people of Peru, from the nations and rulers of Mexico and Brazil? To what heirs did the wealth of the Sultan Ackbar (the Grand Mogul) who died in 1605, descend, amounting in value, chiefly in silver and gold, to three hundred and forty-eight millions of guilders?

Among the European powers Russia stands next, whose gold gains from the Ural mines were estimated from 1814 to 1824, at twenty-four millions of Prussian dollars. Austria, from its mines in Hun-

gary and Transylvania chiefly, obtains a yearly average of four thousand seven hundred marks (sixteen half ounces each), from Bohemia twenty-three, from Salzburg about one hundred and sixty-five marks. France obtained formerly, especially from its gold-washing in Languedoc, about two hundred marks. England has, indeed, no gold mines. Since the abolition of the slave-trade she receives from Senegambia over three thousand four hundred marks; and her iron and steel fabrics, exclusive of all other sources of profit, bring her a larger income than Portugal and Spain formerly obtained in pure gold from their American possessions.

We have here, in our consideration of the metals, been drawn away as it were by the attraction which gold has for our human nature. We are still, however, on the path which leads to our proposed aim,—the consideration of what simple substances consist in.

More than any other material body, gold is adapted to show us what an original substance or element, incapable of being further decomposed by chemical action, is. An element, by its combination with other elements, may furnish the ground-work for other products of nature and art; but to its own origination, it needs no element but that which is actually its own; in all the combinations into which it enters with other bodies it always remains the same, and comes forth again unchanged and ever the same out of such associations.

How entirely different is it with those other natural bodies which are not pure substances. Vermilion or sulphuret of mercury, and galena or sulphuret of lead, when crushed by mechanical force, seem to remain the same even in their smallest particles; under the microscope one sees in the dust of galena, the same cubic forms and shining surfaces which are present to the naked eye in its larger masses. But when the two bodies, the vermilion and the galena, are exposed to a certain degree of heat in company with iron, then the appearance of simplicity soon vanishes; for, in the former, the sulphur forsakes its connection with the quicksilver, and in the latter it separates from the lead and unites itself with the



iron, and becomes sulphuret of iron. It is apparent that these two bodies are not simple substances, but only combinations of substances.

When men began to use gold in buying and selling in order to obtain articles the most various, and learned that for gold all the gratifications of the senses could be procured, they strove all the more eagerly to possess this precious metal. In the course of time gold ceased to be found in its beds of boulder stones and of sand, which had been examined in all directions. It had then to be melted out from its peculiar birth-places—the mountain rocks. Men knocked, therefore, at every stone, exposed all sorts of stones to a melting heat, to ascertain if perchance any gold were hidden therein. There was not then, as now, any need to be sparing of fuel, when whole regions were covered with primeval forests. Smelting-furnaces, those little types of volcanoes, men learned early enough to build, and the earliest nations, like our children now, soon found a special pleasure in melting stones which contained metal, and which were to be distinguished chiefly by their weight. By these experiments very soon all kinds of metals, tin, zinc, and even copper and iron, were obtained from stones, which possessed a quite different form and colour from that of their metals. And by further experiments it was found, for example, that from the melting together of zinc and copper, brass arose,—a metal, which, in colour and brightness, has a certain resemblance to gold. The question next arose, whether gold also could not be made, either by the discovery of a body which might be changed into gold, like calamine into zinc, or by the admixture of another and more easily procured metal with some other substances.

The noble gold has in its way many qualities in common with great and noble minds; namely, patience and gentleness. Without losing its composure, that is, its peculiar material cohesion, it allows itself to be drawn out into wire, and to be beaten into leaves, like no other body. The Nuremberg gold-beaters have a saying, that with a ducat one may gild a rider and his horse. While it bears itself so gently and yieldingly to the cutting knife, gold lets itself be bent and drawn

like no other body in Nature. For this reason, it has never lost its equable bearing under any experiments, to which doubts of the simplicity and purity of its nature gave rise. It was thrown into vinegar, which so readily attacks copper and iron; it was brought into company with common sulphuric acid, and many other artificial productions which have broken so many strong affinities, but gold disdained to mingle its ancient nobility with this newly-made creation of human art. In vinegar, in sulphuric acid, and in a melting heat, it preserved its purity and simplicity. Even heat which changes so many species of ore into oxides and dross, served only to purify gold, inasmuch as it volatilised and dissipated whatever was opposed to that purity.

The chemistry of modern time has, indeed, gone much farther. It has invented quite other and stronger weapons which even the most steadfast metals, the costly diamond and ruby, have been unable to resist. It has succeeded in changing gold into the form of vapour, and in dissolving it in acids of vastly greater strength than any which the ancients could command. With its ingenious electrical and electro-magnetic instruments, it has borrowed the power of the lightning, and it has become possible to chemistry to decompose into several substances water, formerly always ranked among the simple elements, as well as lime, and other earths. But with all these advanced methods it has not been possible to bring the pure simplicity of gold into suspicion. From most of its artificially forced admixtures it has emancipated itself in the heat of fire, which gives it power to repel foreign matter. It has kept itself as an original substance, as one of those simplest primal forms of polarity, which the power of the Creator called forth in the beginning in terrestrial things.

Substances of the same sort are all the metals proper, of which, exclusive of the metallic bases of the earths and alkalis, there are numbered already thirty. Many of these are found rarely and in very small quantities, and some indeed only as little admixtures in other metals, like the living animals found in the intestines of other living animals, as may be said of the

metals *Rhodium* and *Palladium* when they exist, mingled in small quantities with Platinum.

If great rarity only were regarded, and not rather other valuable qualities, very many of the metals would possess a higher money worth, or as high a value as gold. Such was for a time the case with Platinum. For, in addition to its fitness in composition with iron for Damascus razors and metallic reflectors, &c., this metal, by its extraordinarily difficult fusibility and by its resistance to our strongest acids, proved itself so useful in the preparation of chemical apparatus, that it at once commanded a high price. Even now, when it has been discovered in the Ural Mountains in Russia, the price of Platinum, on account of its utility, is four times that of silver; for this dear metal is wrought even into stills for the preparation of sulphuric acid. There are other metals just as rare, or even rarer, which are not of so great utility, and among which two, found in and with Platinum, *Iridium* and *Osmium*\* may be reckoned, whose names, in connection with any purposes of human economy, are as little heard of as those of *Vanadium*, *Cerium*, and *Lanthanum*, or even as those of *Tantalum*, *Titanium*, or *Tellurium*, while perhaps *Cadmium*, which is found in some kinds of zinc-ore, is worthy of mention, on account of its use in the preparation of a gold-colour for fresco-painting.

Next to gold, which has been appreciated from the earliest antiquity, and to platinum, which has recently been discovered, man has ascribed the highest money-value to silver. Its brightness, its white colour, its malleability, and, when it is not alloyed with copper, its property of keeping itself pure from rust, have given it a value in commercial transactions. It comes in much larger masses than gold, and it is reckoned that the quantity of silver brought from America from the beginning of mining operations there in 1492 to 1803, would suffice to fill a room fifty feet high, fifty feet long, and fifty feet broad. In fact, the amount of silver found in America exceeds that obtained during the same time in Europe and Northern Asia more than tenfold,

\* A composition of Iridium and Osmium has been used for tipping gold pens.

although even Germany has had its fortunate mining periods, when it was able to fill, after a more modest measure indeed, the treasure-vaults of its princes, and, at the same time enrich a large portion of its people. Of pure silver, the mark (sixteen half ounces) stands in value at twenty-four guilders. As, however, a piece of silver money of the same size with a piece of gold, is not more than half as heavy as the gold, so would the latter, if, for example, it was of the size of a silver guilder, be worth twenty-seven guilders. For gold, fourteen and one-third times more valuable than silver, weighs nineteen and a half times heavier than water, silver only ten and a half times.

As to the value of the other metals, useful for human purposes,—it is estimated, not by marks and pounds but by hundred weight. Thus do we reckon the value of mercury, so variously useful, which is between thirty and forty times cheaper than silver; and of copper, which is more than eighty times, and of iron, which is more than a thousand times cheaper. Next to iron and copper, the metals which have been most used by man from the earliest times are *tin*, *lead*, and *zinc*. For the use made of *antimony*, particularly in medicine, was not known till the middle ages, and till these modern times, to which we owe also the knowledge of the properties as well as of the application of other useful metals, such as *chromium* for painting on glass and porcelain, and *manganese*, used for colouring glass, and also for obtaining oxygen gas with ease, which is procured by merely heating the most ordinary manganese ore (gray brown-stone ore). In a melting mass of glass, with which a small quantity of pulverised manganese ore has been mixed, the oxygen destroys the colour of the staining parts; and when the manganese ore, mingled with common muriatic acid, is exposed to heat, then, from this acid is formed *Chlorine* gas, which, combined with water, furnishes the bleachers with the means of whitening all cloths and other stuffs which have been coloured with animal or vegetable substances, as it destroys those colours. Such a mixture of chlorine gas with water, even gold cannot resist; it is dissolved therein. The calcination or oxide of the



tolerably rare metal *cobalt* is used in the manufacture of a very enduring blue colour (smaltz, silicate of cobalt), of which one kind is as beautiful as ultramarine. The yet rarer metal *nikel*, which is found in most meteoric stones, keeps as pure from rust as a precious metal, affords, in combination with other ores, valuable compositions (such as argentine, German silver, and others) and is very susceptible of magnetism, and can be used in the preparation of a very beautiful, green colour. The easily fusible *bismuth* shares, with some of its metallic compositions, with the tin-solder of the tinkers, such a great fusibility that it can be melted at the boiling point of water. The very rare metal *Wolfram* requires, on the contrary a very great heat to melt it. It is distinguished by several remarkable properties, as its gravity, which approaches that of gold. In a red heat, it burns (is oxidised) almost like cinder. *Molybdenum* also is melted with great difficulty, and *Uranium* is still less fusible, the yellow and light green oxyde of which is used occasionally as a porcelain colour. The above-named ores, however, are of so little importance for practical purposes that they are commonly placed, in the small quantities in which they are found, in the cabinets of the scientific, where they have in their rude state the most value.

Were it the misuse alone made of any gift of Nature, that should make it offensive to us, one might wish in regard to *arsenic* that it were as rarely to be found, and as hard to be got as many of the just mentioned metals. Still arsenic possesses, with its highly poisonous property, several valuable qualities. It causes platinum, so difficult of fusion, to be easily melted, and so fits it for alloys. Then again in common with many other metals, with copper, for instance, it forms remarkably beautiful compounds, and its acid (arsenic acid), destroys colouring substances, on which account it has become useful in many trades in taking out the colours of many textures. The magnetic power of attraction and repulsion, which belongs peculiarly to iron and nickel, and in a less degree to cobalt and platinum, shows itself analogous to vital force in that, by a slight application of arsenic to the magnetic metal, the magnetic power is as completely

destroyed as animal life is by arsenic. Even the fine sound of some metals is destroyed by an addition of arsenic. It is the poisonous property of this metal, however, which man has made use of as a strong weapon against the ravages of the animal world. Wolves and snakes, as well as the destructive bore-worm, must yield to this weapon.

There are still, even among the most useful metals, and the most easily to be obtained, some which, with all their good qualities, may prove hurtful, and even deadly to the well-being of mankind. Such is the case with *copper* with its easily generated verdigris, and with *lead* and its oxydes and combinations with carbonic acid, likewise easily generated. But shall copper, the richest treasure of so many mountain districts, be, on this account, esteemed less valuable, attesting its utility as it does by its ductility, and by being converted into bronze in composition with tin, and into brass with zinc, and by the covering it furnishes for ships and buildings, and for ore-founderies, recommending itself to the ear in the music of strings and bells, in which copper acts a conspicuous part, and to the eye by its beautiful colours in glass and fresco-painting?

*Tin* also has stood in special favour with man from the earliest times. It is not, indeed, scattered in masses over almost all countries, like iron particularly, and next to iron, lead, and copper. It forms the peculiar wealth of certain regions. And where it is found, it exists in inexhaustible abundance. Thus, England alone, although its tin mines have been wrought now for two thousand years, produces yearly sixty thousand cwt. The East Indies, particularly the eastern peninsula, and the islands of Banca and Lingin, near Sumatra, are so immeasurably rich in tin, that the ore is taken from the surface of the earth almost entirely without mining labour. In Malacca, the rich beds of tin extend over a region of nearly two hundred geographical miles. It is as easily melted, in comparison with iron, as it is obtained. The earliest discoverers of this metal required only a strong coal fire, on a hearth, walled round, to procure it in its pure silver-white, shining state, and to prepare it for manufacture.

(To be continued.)

## LIGHT.

THE physical phenomena of light properly belong to the science of Optics. A knowledge of some of the laws of light is, however, required of all students.

The sun is the great source of light, although we can show many minor and artificial sources. Of the real nature of light we know nothing. Sir Isaac Newton argued that it was a material emanation from the sun and other luminous bodies, consisting of particles so attenuated as to be wholly imponderable to our means of estimating weight, and having the greatest imaginable repulsion to each other. These particles, by his theory, are supposed to be sent forth in straight lines, in all directions, from every luminous body, and which, falling on the delicate nerves of the eye, produce the sense of vision. This is called the Newtonian or corpuscular theory of light. It is not now generally believed to be true, but the language of optical science is formed on the supposition of its correctness. The other view or theory of light, which is now generally accepted, is called the wave or undulatory theory. It is known that sound is conveyed through the air by a series of vibrations or waves, pulsating regularly in all directions, from the original source of the sound. In the same manner it is believed that light is conveyed to the eye by a series of unending and inconceivably rapid pulsations or undulations, imparted from the source of light to a very rare or attenuated medium, which is supposed to fill all space. This medium is called the *luminiferous ether*. However difficult it may be to form any just comprehension of the ultimate or real nature of light, we do know many things about its properties, some of which may be enumerated, and briefly explained.

1st. Light is sent forth in rays in all directions from all luminous bodies. 2nd. Bodies not themselves luminous become visible by the light falling on them from other luminous bodies. 3rd. The light which proceeds from all bodies has the colour of the body from which it comes, although the sun sends forth only white light. 4th. Light consists of separate parts independent of each other. 5th. Rays of light proceed in straight lines.

6th. Light moves with a wonderful velocity, which has been computed by astronomical observations to be at least one hundred and ninety-five thousands of miles in a second of time. This velocity is so wonderful as to surpass our comprehension. Herschel says of it, that a wink of the eye, or a single motion of the leg of a swift runner, or flap of the wing of the swiftest bird, occupies more time than the passage of a ray of light around the globe. A cannon-ball at its utmost speed would require at least seventeen years to reach the sun, while light comes over the same distance in about eight minutes.

When a ray of light falls on the surface of any body, several things may happen. 1st. It may be absorbed and disappear altogether, as is the case when it falls on a black and dull surface. 2nd. It may be nearly all reflected, as from some polished surfaces. 3rd. It may pass through or be transmitted; and 4th. It may be partly absorbed, partly reflected, and partly transmitted. Bodies are said to be opaque when they intercept all light, and transparent when they permit it to pass through them. But probably no body is either perfectly opaque or transparent, and we see these properties in every possible degree of difference. Metals, which are among the most opaque bodies, become partly transparent when made very thin, as may be seen in gold-leaf on glass, which transmits a greenish purple light, and in quicksilver, which gives by transmitted light a blue colour slightly tinged with purple. To protect pictures formed by the daguerreotype process, they are covered with a film of gold or copper, so thin as not to injure the impression, and yet it effectually prevents its removal by the touch. On the other hand, glass and all other transparent bodies stop the progress of more or less light.

DR. FRANKLIN, whose wisdom and knowledge of the world were proverbial, never said a truer thing than this—if every man and woman would work four hours a day at something useful, want and misery would vanish from the world, and the remaining portion of the twenty-four hours might be leisure and pleasure.



## MATERIALS OF ANCIENT BOOKS.

No material for books has, perhaps, a higher claim to antiquity than the skin of the calf or goat tanned soft, and usually dyed red or yellow. The skins were generally connected in lengths, sometimes of a hundred feet, sufficient to contain an entire book, which then formed one roll or *volume*. These soft skins seem to have been more in use among the Jews and other Asiatics than among the people of Europe. The copies of the law found in the synagogues are often of this kind. The most ancient manuscripts extant are some copies of the Pentateuch on rolls of leather.

Parchment—Pergamena, so called long after the time of its first use, from Pergamus, a city of Mysia, where the manufacture was improved and carried on to a great extent, is mentioned by Herodotus and Ctesias as a material which had been from time immemorial used for books. It has proved to be of all others, except that abovementioned, the most durable. The greater part of all manuscripts that are of higher antiquity than the sixth century are on parchment; as well as, generally, all carefully written and curiously decorated manuscripts of later ages. The palimpsests are usually parchments: "It often happened," says Montfaucon, "that from the scarcity of parchment, the copyists, having erased the writing of ancient books, wrote upon them anew. These re-written parchments were called palimpsests—scraped a second time, and often the ancient work was one of far greater value than that to which it gave place. This we have on many occasions had opportunity to observe in the MSS. of the king's library, and in those of Italy. In some of these rescripts the first writing is so much obliterated as to be scarcely perceptible; while in others, though not without much labour, it may still be read.

The practice, still followed in the east, of writing upon the leaves of trees, was common in the remotest ages. The leaves of the mallow or of the palm were most used for this purpose. They were sometimes wrought together into larger surfaces; but it is probable that this fragile and inconvenient material was only em-

ployed for ordinary purposes of business, letter-writing, or the instruction of children.

The inner bark of the linden or teildee, and perhaps of some others, called by the Romans *liber*, by the Greeks *biblos*,\* was so generally used as a material for writing as to have given its name to a book in both languages. Tables of solid wood called *codices*, whence the term *codex* for a manuscript on any material, has passed into common use, were also employed, but chiefly for legal documents, on which account a system of laws came to be called a code. Leaves or tablets of lead or ivory are frequently mentioned by ancient authors as in common use for writing. But no material or preparation seems to have been so frequently employed on ordinary occasions as tablets covered with a thin coat of coloured wax, which was readily removed by an iron needle, called a *style*; and from which the writing was as readily effaced by the blunt end of the same instrument.

But during many ages the article most in use, and of which the consumption was so great as to form a principal branch of the commerce of the Mediterranean, was that manufactured from the papyrus of Egypt. Many manuscripts written upon this kind of paper in the sixth, and some even so early as the fourth century, are still extant. It formed the material of by far the larger proportion of all books from very early times till about the seventh or eighth century, when it gradually gave place to a still more convenient manufacture.

The papyrus, or Egyptian reed, grew in vast quantities in the stagnant pools formed by the inundations of the Nile. The plant consists of a single stem, rising sometimes to the height of ten cubits; this stem, gradually tapering from the root, supports a spreading tuft at its summit. The substance of the stem is fibrous, and the pith contains a sweet juice. Every part of this plant was put to some use by the Egyptians. The harder and lower part they formed into cups and other utensils; the upper part

\* The word *biblos* or *byblos*, was afterwards almost appropriated to books written upon the paper of Egypt.

into staves, or the ribs of boats; the sweet pith was a common article of food; while the fibrous part of the stem was manufactured into cloth, sails for ships, ropes, strings, shoes, baskets, wicks for lamps, and, especially, into paper. For this purpose the fibrous coats of the plant were peeled off, the whole length of the stem. One layer of fibres was then laid across another upon a block, and being moistened, the glutinous juice of the plant formed a cement, sufficiently strong to give coherence to the fibres; when greater solidity was required, a size made from bread or glue was employed. The two films being thus connected, were pressed, dried in the sun, beaten with a broad mallet, and then polished with a shell. This texture was cut into various sizes, according to the use for which it was intended, varying from thirteen to four fingers' breadth, and of proportionate length.

By progressive improvements, especially in the hands of the Roman artists, this Egyptian paper was brought to a high degree of perfection. In later ages it was manufactured of considerable thickness, perfect whiteness, and an entire continuity and smoothness of surface. It was, however, at the best, so friable that when durability was required, the copyists inserted a page of parchment between every five or six pages of the papyrus. Thus the firmness of the one substance defended the brittleness of the other; and great numbers of books so constituted have resisted the accidents and decays of twelve centuries.

Three hundred years before the Christian era, the commerce in this article had extended over most parts of the civilized world; and long afterwards it continued to be a principle source of wealth to the Egyptians. But at length the invention of another manufacture, and the interruption of commerce occasioned by the possession of Egypt by the Saracens, banished the paper of Egypt from common use. Comparatively few manuscripts on this material are found of later date than the eighth or ninth century; though it continued to be occasionally used long afterwards.

The charta bombycina or cotton paper, often improperly called *silk* paper, was

unquestionably manufactured in the east as early as the ninth century, possibly much earlier; and in the tenth it came into general use throughout Europe. This invention, not long afterwards, became still more available for general purposes by the substitution of old linen or cotton rags for the raw material; by which means both the price of the article was reduced, and the quality improved. The cotton paper manufactured in the ancient mode is still used in the east, and is a beautiful fabric.

From this brief account of the materials successively employed for books, it will be obvious, that a knowledge of the changes which these several manufactures underwent will often serve, especially when employed in subservience to other evidence, to ascertain the age of manuscripts; or at least to furnish the means of detecting fabricated documents.

The preservation of books, framed as they are of materials so destructible, through a period of twelve or even fifteen hundred years, is a fact which might seem almost incredible; especially as the decay of apparently more durable substances within a much shorter period, is continually presented to our notice. The massive walls of the monasteries of the middle ages are often seen prostrate, and fast mingling with the soil; while manuscripts penned within them, or perhaps when their stones were yet in the quarry, are still fair and perfect, glittering with their gold and silver, their cerulean and cinnabar.

But the materials of books, though destructible, are so far from being in themselves perishable that, while defended from positive injuries, they appear to suffer scarcely at all from any intrinsic principle of decay, or to be liable to any perceptible process of decomposition. "No one," says Father Mabillon,\* "unless totally unacquainted with what relates to antiquity, can call in question the great durability of parchments; since there are extant innumerable books written on that material, in the sixth and seventh centuries; and some of a still more remote antiquity, by which all doubt on that subject may be removed. It may suffice

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\* "De Re Diplomatica."



here to mention the Virgil of the Vatican Library, which appears to be of more ancient date than the fourth century; and another in the King's Library, little less ancient; also the Prudentius, in the same library, of equal age; to which you may add several, already mentioned, as the Psalter of St. Germanus, the book of the councils, and others, which are all of parchment. Many other instances I might name, if it were proper to dwell upon a matter so well known to everyone who is acquainted with antiquity.

"The paper of Egypt, being more frail and brittle, may seem to be open to greater doubt; yet there are not wanting books of great antiquity, by which its durability may be established. To go no further, there is in the Royal Library a very old codex written upon the phylra (or bark of the linden-tree) containing the homilies of Avitus—I mean the copy from which the celebrated Jac. Sirmundus prepared his edition; we have also seen two other codices of the same material in the Petavian Library, containing some sermons of St. Augustine, which, in the opinion of the learned, are about 1100 years old. Of the same kind is that rare and very ancient codex in the Ambrosian Library, mutilated indeed, but consisting of many leaves of Egyptian paper, which contain some portions of the Jewish history of Josephus. These examples are sufficient to demonstrate the durability of the Egyptian paper in ancient books." The author then goes on to mention several instances of deeds and charters written upon the paper of Egypt, still extant, though executed in the fourth and fifth centuries.

Books have owed their conservation, not merely to the durability of the material of which they were formed, but to the peculiarity of their being at once precious, and yet not (in periods of general ignorance) marketable articles; of inestimable value to a few, and absolutely worthless in the opinion of the multitude. They were also often indebted for their preservation in periods of disorder and violence to the sacredness of the roofs under which they were lodged.

UNCHARITABLE persons are generally more unthinkingly than perversely so.

## SCIENCE.

THE world in primal darkness lay,  
Enwrapt in gloomiest night,  
Without a single glimmering ray  
To lend its friendly light.

Enveloped was the human mind,  
In darkness drear and dread,  
Man's noble powers were all confined—  
By no kind beacon led.

At length the star of Science rose  
This darkness to dispel,  
Creation's mysteries to disclose,  
And Nature's wonders tell.

Upon her balmy wings she bore  
The thoughts of man away,  
And bade him boundless worlds explore—  
No more in darkness stay.

She bade him walk the ethereal blue  
Where countless planets shine,  
With knowledge pure his mind imbue,  
Knowledge almost Divine.

Glad man obey'd; to him the keys  
Of knowledge then were given;  
The elements obey'd his will,  
And own'd him child of Heaven.

The lightning's glare that rends the sky,  
When storms in anger meet,  
Dread agent of destruction's power,  
Falls harmless at his feet.

He rides upon the briny deep,  
Where foaming billows rise,  
O'er rocks and hills with mighty speed  
At will he swiftly flies.

And science shows His handiwork,  
Who form'd this world of ours,  
And bids us rev'rence and adore  
The God of wondrous powers.

Science, Religion's handmaid is,—  
Best boons to mortal given,  
Expanding all man's noble powers,  
Then leading him to Heaven!

SEARCH AFTER HAPPINESS.—If you cannot be happy in one way be happy in another; and this facility of disposition wants but little aid from philosophy, for health and good-humour are almost the whole affair. Many run about after felicity, like an absent man looking for his hat while it is on his head or in his hand.

## MAKING EXCUSES.

The following hints apply to teachers, and will cause them, we trust, to *avoid making excuses for the defects of the schools in which they assist.*

I think it was Franklin that said, "A man who is good for making excuses is good for nothing else." I have often thought of this as I have visited the schools of persons given to this failing. It is sometimes quite amusing to hear such a teacher keep up a sort of *running* apology for the various pupils. A class is called to read. The teacher remarks, "This class has just commenced reading in this book." Stephen finishes the first paragraph, and the teacher adds, "Stephen has not attended school very regularly lately." William reads the second. "This boy," says the teacher, "was very backward when I came here—he has but just joined this class." Mary takes her turn. "This girl has lost her book, and her father refuses to buy her another." Mary here blushes to the eyes; for though she could bear his reproof, she still has some sense of family pride; she bursts into tears while Martha reads the next paragraph. "I have tried all along," says the teacher, "to make this girl raise her voice, but still she will almost stifle her words." Martha looks dejected, and the next in order makes an attempt.

Now the teacher, in all this, has no malicious design to wound the feelings of every child in the class, and yet he has as effectually accomplished that result as if he had premeditated it. Every scholar is interested to read as well as possible in the presence of strangers; every one makes the effort to do so, yet every one is practically pronounced to have failed. The teacher's love of approbation has so blinded his own perception that he is regardless of the feelings of others, and thinks of nothing but his own.

The over-anxiety for the good opinion of others shows itself in a still less amiable light, when the teacher frequently makes unfavourable allusions to his predecessor. "When *I came here*," says the teacher, significantly, "I found them all poor readers." Or, if a little disorder

occurs in school, he takes care to add, "I *found* the school in perfect confusion;" or, "the former teacher, as near as I can learn, used to allow the children to talk and play as much as they pleased." Now whatever view we take of such a course, it is impossible to pronounce it anything better than *despicable meanness*. For if the charge be true, it is by no means magnanimous to publish the faults of another; and if it is untrue in whole or in part, as most likely it is, none but a contemptible person would magnify another's failings to mitigate his own.

There is still another way in which this love of personal applause exhibits itself. I have seen teachers call upon their brightest scholars to recite, and then ask them to *tell their age*, in order to remind the visitor that they were very young to do so well; and then insinuate that their older pupils could of course do much better.

All these arts, however, recoil upon the teacher who uses them. A visitor of any discernment sees through them at once, and immediately suspects the teacher of conscious incompetency or wilful deception. The pupils lose their respect for a man whom they all perceive to be acting a dishonourable part. I repeat, then, *never attempt to cover the defects of your schools by making ridiculous excuses.*

PASTORAL INFLUENCE.—There is a charm in the week-day services of a parish minister, which has not been duly estimated either by philanthropists or patriots. His official and recognised character furnishes him with a passport to every habitation; and he will soon find that a visit to the house of a parishioner is the surest way of finding access to his heart. Even the hardest and most hopeless in vice, cannot altogether withstand this influence; and, at times, in their own domestic history, there are opportunities, whether by sickness, or disaster, or death, which afford a weighty advantage to the Christian kindness that is brought to bear upon them. His week-day attentions, and their Sabbath attendance go hand in hand. It is thus, that a house-going minister wins for himself a church-going people.—DR. CHALMERS.



EASTERN RAMBLES AND  
REMINISCENCES.

## RAMBLE THE TWENTY-SIXTH.

VISIT TO MUNYCHIA, THE DIONYSIAC THEATRE—THE TOMB OF THEMISTOCLES; ITS SITE DISPUTED—DESCRIPTION OF THE SPOT—MUNYCHIA FORMERLY AN IMPORTANT POSITION—THE PHALERUS—THE CENOTAPH OF KARAISSAKI—THE HALF-WAY HOUSE AND ITS LANDLORD—THE ROAD TO ATHENS—FIRST VIEW OF THE CITY—THE TEMPLE OF THESEUS—THE ACROPOLIS, WITH ITS VARIOUS BUILDINGS—THE PARTHENON—THE TEMPLE OF VICTORY—THE ERECTHEUM—THE MUSEUM—VIEW FROM THE PARTHENON.

No breath of air to break the wave  
That rolls below the Athenian's grave,  
That tomb which, gleaming o'er the cliff  
First greets the homeward-veering skiff,  
High o'er the land he saved in vain;  
When shall such hero live again!

\* \* \* \*

'Tis Greece, but living Greece no more!  
So coldly sweet, so deadly fair,  
We start, for soul is wanting there.  
Her's is the loveliness in death,  
That parts not quite with parting breath;  
But beauty with that fearful bloom,  
That hue which haunts it to the tomb.  
Expression's last receding ray,  
A gilded halo hovering round decay,  
The farewell beam of feeling past away!  
Spark of that flame, perchance of heavenly  
birth,  
Which gleams, but warms no more its cherish'd  
earth."

BYRON.

Still be that cloud withdrawn. Oh! mark on  
high,  
Crowning yon hill, with temples richly graced,  
That fane, august in perfect symmetry,  
The purest model of Athenian taste.  
The Parthenon! thy Doric pillars rise  
In simple dignity,—thy marble's hue  
Unsuiled shines, relieved by brilliant skies  
That round thee spread their deep ethereal blue;  
And art o'er all thy light proportions throws  
The harmony of grace,—the beauty of repose.

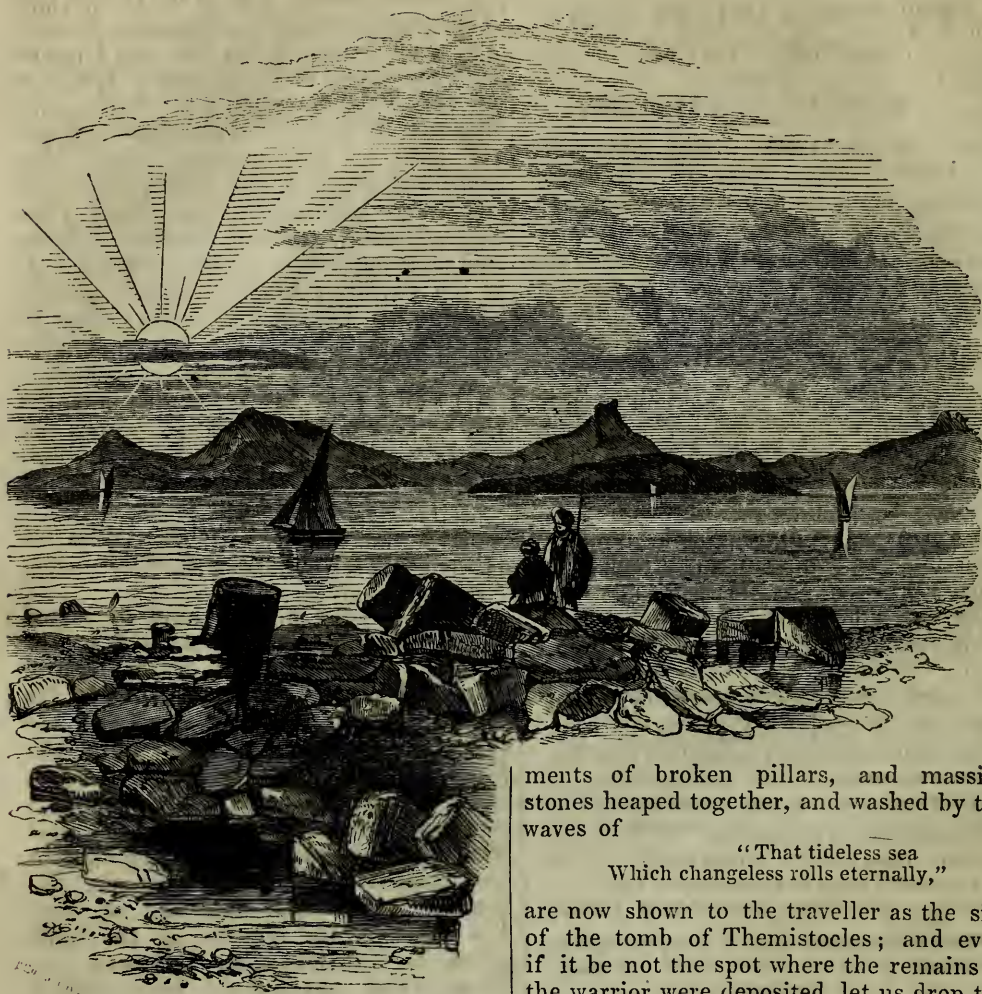
MRS. HEMANS.

BEFORE proceeding to Athens, we determined to visit the old port of Munychia, where the remains of a small theatre are now to be seen. I say the remains, but perhaps it would have been better had I said traces of the existence of a small theatre, as the foundations are destroyed in many parts, and little now remains but

the general form. This is the theatre that Thucydides calls the Dionysiac theatre, and is no doubt the one that the Hoplitæ took possession of in the twenty-first year of the Peloponnesian war, during the disputes between the Four Hundred and the party of Theramense. Here they consulted together, and having taken the necessary precautions, and made their arrangements, marched against Athens, and took possession of the Anaceium. It is not necessary to follow up this portion of Grecian history any further than to mention that the Four Hundred were deposed, and a new government formed.

Walking over the rocks that girt the sea and are washed by its waves, we came to the tomb of the Greek Admiral Miaulis, an unpretending structure of soft stone, built in three courses, with a slab on the land side, merely stating his rank and name and the date of his death, 1838.

After passing a rude kind of signal house or lighthouse, we arrived in the immediate neighbourhood of the tomb of Themistocles, the victor of Salamis, the fortifier and improver of the Peiræus, and restorer of Athens. There were two Greeks fishing from the rocks near to where the remains of his sarcophagus is now buried beneath the waves. Around were the broken fragments of large columns and massive stones washed by the sea, bearing unequivocal evidence of age, and probably the remains of the tomb which is mentioned by Diodorus and Plato, which had a large basis, with a monument upon it resembling an altar. The only difficulty that I see is the presence of the columns, which certainly would not belong to the general form of the altar-shaped monuments of the Greeks, because no doubt many of my readers are aware that there has been much controversy on the subject, some contending that it is not the tomb of Themistocles, others that it is, and some again asserting that both are wrong. It is a great pity that there should be any doubt about the subject, it takes away half the interest that would otherwise be attached to the locality, and makes us question even the originality of other sites. Whether it be the tomb or not, whether its site is that pointed out by Plato in the following lines,



TOMB OF THEMISTOCLES, WITH EGINA IN THE DISTANCE.

which were preserved by Plutarch and translated by Cumberland, I will not attempt to say :

“By the sea’s margin, on the watery strand,  
Thy monument, Themistocles, shall stand;  
By this directed, to thy native shore,  
The merchant shall convey his freighted store;  
And when our fleets are summon’d to the fight,  
Athens shall conquer with thy tomb in sight.”

Elegant and pathetic as these lines are, yet they also convey the historical fact, that a tomb or monument, or perhaps both, was once actually to be seen on that spot, or near unto it. In the present day, the remains of a sarcophagus, the frag-

ments of broken pillars, and massive stones heaped together, and washed by the waves of

“That tideless sea  
Which changeless rolls eternally,”

are now shown to the traveller as the site of the tomb of Themistocles; and even if it be not the spot where the remains of the warrior were deposited, let us drop the antiquarian and become the romancist, or aught else you choose, so long as the pleasing illusion is not destroyed, that hereabout is all that remains of the conqueror of Salamis. Thucydides averred that his monument was to be seen in the forum of Magnesia, where he died, and hints, that the report of his bones being buried *somewhere* in Attica, is untrue. Diodorus somewhat refutes this, and modern authorities have not brought forward any conclusive arguments in favour of the settlement of this question. Perhaps it does not matter where he was buried; but, wherever it was, I will only say, that it could not be in a more appropriate spot than the one now shown as the tomb of Themistocles; for to the left is Salamis—



the site of his great naval triumph; behind is Athens and the Peiræus, with its once celebrated long walls; and before us the hills of Morea with the setting sun, throwing its glorious hues on the murmuring waves as they break over the time painted stones on that desolate spot.

"And the fringe of the foam may be seen below,  
On the line that it left long ages ago:  
A smooth short space of yellow sand  
Between it and the greener land."

How changed the spot!—the people, and Greece itself, since the day when Themistocles was hailed as the Victor of Salamis!

Leaving the tomb and continuing the course of the walls, we arrived at last in Munychia Bay, so called from Munychus, an Orchomenian, who was expelled by the Thracians from Boeotia, and afterwards settled at Athens. Here are the remains of the tomb of Thrasson, and a temple to Diana. When it was fortified and connected with other ports by the walls, Munychia became a most important position, because the fleets of Athens found it a harbour of refuge that could be depended upon; and, consequently, as its position was so important, it was sedulously guarded from sea attacks.

Still further on is the most ancient of all the Athenian ports, and certainly the smallest. I mean the Phalerus, where there was a celebrated temple to Ceres, to which the young Greek damsels used in the old days of temples and such like, to bring bunches of nice ripe grapes as offerings at the feasts—made by the priests—in her honour.

Phalerus was the birth-place of Demetrius and Aristides, and is said to have had several statues erected to unknown gods. After the Peiræus was finished, it ceased to be an important place, and although enclosed within the fortifications constructed by Themistocles, yet was never accounted a strong place, perhaps because the walls were hastily made. It is now more celebrated for its cabbages and marsh, than for being of any importance in a maritime point of view.

"Onward!" was the word, and away we sped over the rugged road, and soon arrived on the borders of a small plain, in the centre of which is a monument erected to the memory of Karais Kaki and the Greeks who fell in the action with the

Turks in 1827, when Lord Cochrane and Sir R. Church made an unsuccessful attempt to take Athens, and had to retreat with the loss of many men. It is a simple monument erected over the spot where many of the slain were buried. Many skulls and thigh-bones were protruding from the earth, while others were laying upon the surface, or in the ditch around the cenotaph.

Passing many a picturesque group of labourers travelling along the road to Athens, which is a very tolerable one, and indeed, even pleasant when not too dusty, we arrived at a half-way house kept by a Greek, who I believe is a great villain. Here were a great many cabs resting to give their horses water, and allow their drivers time to take a dram. It is rather a pretty house, with some nice trees around it, and would form a pleasant resting-place and retreat during the hottest part of the day, except for the landlord, who is, as I observed before, a great rascal.

No sooner did he observe us, than he left the doorway where he had been lounging, smoking a paper cigar and twisting his moustaches, and shouted out "Ah, my shentlemen! Mi capitan! My chummy! How you do? You no know Athens! Come, take some room, or praps you like him lemonade, or rachee, or orgeat, ah? All vary good, mi capitan, my midshipman, my chummy. Inglesi and Greek, sour, sour. Hah! hah! hah! Vell, vat you take? No? take nothing. Ah! you no good. Me chummy, you know, and sometime you like him chummy to give you the room or the orgeat."

The appearance of this host of the roadside was not sufficiently prepossessing to tempt us just then, so we passed on towards Athens, heartily glad to leave mine host behind.

The road to Athens is very agreeable at most seasons of the year; but unless compelled to proceed to the city in the middle of the day, it is advisable to choose the morning and return in the cool of the evening, not only on account of the heat, but also the dust, which is frequently blown in dense clouds along the road. The pleasantest part of the road is that between the half-way house and the city, but I generally selected the lower road passing through the groves of Aca-

demus, and thus escaped much dust and heat.

In the cool of evening, when the rising moon peeps forth

"From the slow-opening curtains of the clouds,  
Walking in beauty to her midnight throne!"

her placid beams resting upon the sacred olive trees, and the little Venetian oratory at the turn of the road, mottling with mazy shades the neglected spot, we enjoy a walk through the groves of Academus, where the voices of the first philosophers of Greece have resounded, and the thunders of applause re-echoed.

The plain of Athens is not very fertile, but the husbandmen do not understand agriculture sufficiently to make it productive. As a plain only, it is generally acknowledged to be a fine one. In many parts we meet with clusters of olive and mulberry trees, small vineyards, and fields with many kinds of vegetables.

My first view of the city did not prepossess me in its favour, and perhaps, as I was disappointed, my mind may have become somewhat prejudiced, and determined not to like Athens. There were so many painful associations connected with the surrounding scenes, now desolate—the remnants of some of the noblest specimens of the sculptor's art were thrown in a heap on the road-side,—a warning of the downfall of human greatness and pride; and ugly misshapen houses—hovels would be a better term—were heaped together as if it had been necessary to get as many of them into a given space as possible without any regard to size, form, or arrangement.

My imagination inflamed by the poetry of Byron, relics in the British Museum, pretty engravings, and the writings of some travellers who have given an account of the agreeables without even alluding to the fact that there were also some drawbacks, together with my early readings in connection with Grecian history, made me picture Athens as the most beautiful city it was possible to visit. It was once the seat of wisdom and the arts, celebrated for her literature, the favoured city of Minerva, the mistress of Greece, and rival of Lacedæmon in military prowess, but is now a miserable, gloomy city, with cramped houses, crooked filthy lanes, and crumbling ruins. Her painters, poets,

philosophers, historians, warriors, statesmen, and orators, are to be found only in the page of history; her temples and palaces, with other proud monuments of art, are either destroyed or crumbling away amid the hovels of the degraded nation; and all around you awakens painful associations, especially to the scholar and artist.

The first place to which we paid a visit was the Temple of Theseus, which stands at the western end of the town outside the walls. It is of the Doric order, and the most perfect temple in Greece. It is built of the finest white Pentelic marble, and is *exactly* one-fourth the size of the Parthenon, which is said to have been built thirty years after it. The walls and 34 columns remain entire, and considering that it was built by Cymon, the son of Miltiades, fifteen years after the battle of Salamis (B. C. 450), it is in a wonderful state of preservation. The frieze at each end represents the combat between the Centaurs and the Lapithæ, and the metopes are embellished with the deeds of Theseus, and the labours of his companion Hercules, all beautifully sculptured. After the revolution it was consecrated as a church, and dedicated to St. George, but it is now converted into a museum of antiquities, where a great many statues, slabs, broken marbles, altars, and stones with inscriptions, are collected, numbered, and arranged. Some of these antiquities are very fine, and I also noticed several good plaster casts. Among the most remarkable for beauty, preservation, and spirit, are the figures of Pan, Bacchus, Janus, Apollo, Hercules, and one of the Athletæ, Seneca drinking the poison, and a vast number of tablets illustrative of the manners and customs of the ancient Greeks. I also observed some sarcophagi and fine vases.

After leaving the Temple of Theseus, we passed the Hill of Mars, and entered the famed Acropolis; the approach to which is obstructed by heaps of rubbish, portions of broken columns, and other parts of the ruins.

From the earliest ages to the last days of the late war, the Acropolis was always a fortress, but not a strong or desirable one, on account of its position being commanded, and its deficiency of water.



The ancient city which was fortified at first with palisades, was sixty stadia or about three miles in extent, and surrounded by olive trees; but, after a time it was enclosed by walls, forming a circuit of 2,530 yards, and having one large and eight small gates. These were built on the edge of the perpendicular rock, which rises 150 feet above the level of the plain, and the old foundations may now be seen, crowned with the work of the Venetians and Turks in some parts, while in others the original work remains untouched. The area which they enclose is nearly 500 yards long, and 167 yards at its extreme breadth.

After procuring a guide, we entered the small guard-room just within the rude wooden gate, and then a short farce was played in which our treasurer took the chief part, the guide the second, and the soldiers the remaining. No doubt our treasurer was the prop of the piece, at any rate he assisted in *supporting* the other actors. After this little affair had terminated by the usual process of paying drachmas,\* we passed some ancient tablets placed against the wall on our left, and then, turning to the right, passed through a wooden gate, and at once came in front of the Propylæa, which may be considered as the title-page to what is to follow, and a noble one it is too, but is now a little the worse for wear, although enough is still left to let you see that the work was illustrated with cuts.

The Propylæa were commenced at a time when Athens was in the zenith of her power, when Euthymenes was archon, and were finished in five years.

As you stand upon the heap of rubbish, in front of it, and look upward, the effect is very good; and, if your imagination is lively, the scene may be admirably filled up, and the deficiency of work, in some parts, readily restored. Even now it has a front of six marble pillars of the Doric order with frieze entablature, &c., and on either side is a wing of square and solid masonry of all sizes. The wing on your left (that is the right wing), was the picture gallery, but is now occupied by fragments of sculpture, inscriptions and other antiquities. The right wing is

similarly occupied; and adjoining it is a high square tower, built in the middle ages, an unsightly object to the scholar or antiquary. Nearly in front of the north wing, is a lofty pedestal of white marble, and on the other side are the remains of a similar one. These are said to have been erected for two statues, the former having been surmounted with that of Agrippa, and the latter by one of Augustus.

Having sketched the Propylæa, I scrambled over the rubbish and seated myself upon one of the steps, and enjoyed the fine view before me. Far distant was the island of Egina, the bay of Salamis, and the Peiræus, with the road to Athens, the groves of Academus, and the Temple of Theseus. Immediately before me was the Temple of Victory, the pedestal of Agrippa, and the heap of rubbish I had just scrambled over.

When I had made a sketch of the view from the steps of the Propylæa, we passed through the centre of this structure, and turning a little to the right, saw the famous Parthenon before us, rising in all its majesty from its own ruins.

The Parthenon is erected upon the highest ground in the city, forming the centre of the Acropolis, and therefore the heart of the city. This noble structure, which has been accounted by many the finest edifice in the world, was built of the purest Pentelic marble, during the reign of Pericles. Its height was 65 feet above the platform on which it stands, which is itself raised three steps above the ground: its length was 228 feet, and its breadth 100 feet. It is unnecessary here to give a detailed description of its columns, friezes, entablatures, &c., they are more interesting to the antiquary and architect than to the general reader; but I consider it necessary to mention that the frieze on the outside represented the procession to the Parthenon, on the grand quinquennial festival of the Panathenæa, and those who may wish to form some idea of its beauty, will find many portions of the original in the British Museum, and the deficient parts supplied by plaster casts, taken at Athens.

The Emperor Adrian repaired and beautified this building, and it remained in tolerable preservation until 1687, when it was almost destroyed by the Venetians,

\* A drachma is valued at about eightpence-halfpenny.

by a shell falling on a part of the roof, underneath which was a temporary powder-magazine. The columns also suffered greatly during the last war, many of them being split by the cannon-balls, the fluting greatly damaged, and large pieces knocked off in several places. The Turks also assisted in the destruction of this gem of architecture, for they not only formed cannon-balls of the marble of the Temple, when their iron balls had all been fired away, but they also pounded many of the columns to make mortar to build up walls to fortify the place.

The guide pointed out a space about eight feet long and four feet wide, paved with common stone, in the centre of the marble floor of the Temple. This he told us was the place where the sacrifices were made, and that it was paved thus for fear the blood and fire should stain the white marble floor. This may be true, but who can say it is or is not? It is all conjecture. Not far from this spot was the place where the celebrated statue of Minerva by Phidias stood. This magnificent piece of sculpture was executed in gold and ivory.

We now retraced our steps and paid a visit to the little temple of Victory, *Apteros* or *without wings*, which adjoins the gothic tower near to the Propylæa. It consists of two porticoes, each having four fluted Ionic columns, connected by a cella of solid masonry. The temple itself is only about 20 feet long, and about 19 feet high, but it is a beautiful object, and pleasantly situated. There is a curious history attached to it; Pausanias mentioned it, and it was seen by Wheeler, and Spohn in 1681, but until within the last fifteen years no one was able to discover it. The present government, in carrying on their work of restoration of the antiquities, had occasion to remove a Turkish battery, which stood in front of the Propylæa, and was partially constructed of the ruins themselves. In doing so portions of pillars, friezes, and other ornamental work, were discovered, and as the work proceeded, the floor of an ancient temple was observed; the rubbish was removed, and the original portions collected, and re-erected on the old site. Some portions of the frieze are wanting, but they are in the British Museum, and only casts of them at Athens.

Our next visit was to the Erechtheum, which is on the north of the Parthenon, and is generally considered to be three temples joined together, although it appears more proper to regard it only as two, with a communicating corridor. The eastern chamber was dedicated to Minerva Polias, and contained a statue of that goddess, who was considered as the protectress of the city. The western chamber was the temple of Pandrosus, where it is said Neptune struck the rock with his trident in the presence of Cecrops, and forthwith a spring of sea-water issued from it, and the impression of the trident remained on the rock as a pledge of the future naval power of Athens. The same chamber is said to have contained the sacred olive-tree of Minerva, which she produced from the earth as her pledge of the peace and plenty that should reign over the land. Thus it was that Minerva and Neptune strove for the benefit of Athens.

The most peculiar and striking feature of the Erechtheum, is the caryatid portico, which was partially destroyed during the siege of Athens in 1827, but has since been restored by the present government. It was here that the Athenian women took refuge during the siege, and so many perished by the fall of the roof. There is something peculiarly graceful about the Caryatides supporting the marble beams of the roof.

Our time had been so fully occupied by rambling over the ruins and sketching, that we had not much time left for a visit to the Museum, which is established within the Acropolis. It is a rude building, with a crazy wooden staircase, but contains some very beautiful pieces of antique sculpture, pottery, ornamental work, mosaic and other antiquities. Below the room in which they were exhibited was another, where an Italian sculptor was at work copying some fine specimens of his art from plaster casts; possibly with a view to replacing those taken away by Lord Elgin, and afterwards sold to the British government for £35,000. He had just finished one of the Caryatides at the period of our visit.

As we were about to leave, the guide persuaded us to ascend some steps in a tower to the right and then crawl along



part of the roof in order to observe the sunset, and also the view from the summit of the Parthenon. It was a splendid sight, amply repaying us for the trouble, and cannot be better described than in the following beautiful lines of Byron, which were forcibly brought to mind by the scene before us :

"Slow sinks, more lovely ere his race be run,  
 Along Mœrea's hills the setting sun :  
 Not, as in northern climes, obscurely bright,  
 But one unclouded blaze of living light !  
 O'er the lush'd deep the yellow beam he throws,  
 Gilds the green wave, that trembles as it glows,  
 On old Ægina's rock, and Idra's isle,  
 The god of gladness sheds his parting smile ;  
 O'er his own regions ling'ring, loves to shine,  
 Though there his altars are no more divine :  
 Descending fast the mountain shadows kiss  
 Thy glorious gulf, unconquered Salamis !  
 Their azure arches through the long expanse  
 More deeply purpled meet his mellowing glance,  
 And tenderest tints, along their summits driven,  
 Mark his gay course, and own the hues of heaven ;  
 Till, darkly shaded from the land and deep,  
 Behind his Delphian cliff he sinks to sleep."

GARRICK AND DR. STONEHOUSE.—Dr. Stonehouse is said to have been one of the most correct and elegant preachers in the kingdom. When he entered into holy orders he took occasion to profit by his acquaintance with Garrick, to procure from him some valuable instructions in elocution. Being once engaged to read prayers, and to preach at a church in the city, he prevailed upon Garrick to go with him. After the service, the British Roscius asked the doctor what particular business he had to do when the duty was over ! "None," said the other. "I thought you had," said Garrick, "on seeing you enter the reading-desk in such a hurry." "Nothing," added he, "can be more indecent, than to see a clergyman set about sacred business as if he were a tradesman, and go into the church as if he wanted to get out of it as soon as possible." He next asked the doctor what books he had in the desk before him. — "Only the Bible and Prayer-book."—"Only the Bible and Prayer-book," replied the player, "why, you toss them backwards and forwards, and turn the leaves as carelessly as if they were those of a day-book and ledger." The doctor was wise enough to see the force of the observations, and ever after avoided the faults they were designed to reprove.

## HOME PREPARATIONS FOR SCHOOL.

A good education, the proper cultivation of the intellectual powers, consists not so much in the *amount of knowledge acquired*, as in the *ability to acquire knowledge* ; not so much in the ability to receive instruction from the lips of another, as in the ability to investigate truth for one's self ; not in having difficulties made easy and taken clean out of the way, but in removing them by one's own effort. Such being the design of learning lessons, it is obvious that lessons learned at home are ordinarily much more valuable than lessons learned at school.

How are lessons commonly learned at school ?

The pupil sits down to his task which is to be recited at a given time. He meets with a difficulty—a little time is spent upon it, and if he cannot pretty readily solve it, he applies to his teacher for help, or obtains permission to speak to another in whose power he has more confidence than in his own. He would often study longer by himself, but time passes, and if he waits the lesson will not be ready in season for recitation. Or, it may be, he passes over with little study the more difficult parts of the lesson, learning only the easier, and depending upon help from the teacher at time of recitation, which is near at hand. Even if the lesson is well learned, the pupil passes directly from the book to the recitation.

Contrast this with the manner of learning the lesson at home. It is comend over in the evening ; if difficulties occur, they become the subject of careful and deliberate thought. Again and again does he return to his task ; it is among the last thoughts before he sleeps, and among the first when he wakes. And he soon learns by experience that difficulties which careful and patient study seems not to remove in the evening, do, frequently, after such evening study, vanish with the night ; what was dark, or dimly seen the previous evening, is now bright as the rising sun. Such an exercise begets strength—strength of intellect ; strength of purpose ; confidence in one's own powers ; and an independence

of the aid of others, which he seldom feels whose study hours are confined to the school-room. Is not the pupil's education very much more advanced by such home study than by lessons ordinarily learned at school?

Let us suppose a school term to consist of twelve weeks, and that one such lesson is learned per day, making seventy-two lessons in the term. What a stride has the pupil taken in his education, which he has not begun to take whose studies have been confined to the school-room. Not only has he learned these seventy-two lessons, but his mind has been more cultivated by the exercise than it would be by learning twice seventy-two lessons in the school-room. Nor is this all. His progress in study in school to-day is all the easier and the more rapid and pleasant in consequence of the exercise of the last evening. Moreover, each successive evening lesson becomes easier as the mind acquires strength by such deliberate and patient study. Longer tasks are cheerfully undertaken and learned.

We all frequently say to our pupils that their education is but *begun* at school; that all that can be done there is to lay the *foundation* for an education; the erecting of a superstructure must be the work of a life. We would teach them that the education acquired while at school is by no means complete. If they would be highly useful, they must continue, at home, the studies which have been commenced at school. They must choose for their literary companions, not the novelist, and the miserable scribblers of the light literature of the day, which are taken as the only companions of so many of our youth on leaving the school-room; but they must select the works of men and women who have thought much, whose minds have been disciplined by study; whose writings can be appreciated only by minds disciplined by study, which, indeed, will be read by few whose minds have not been accustomed to study.

But will the youth who has been taught by long years of training that school-books, books that require study, are for the school-room only—whose fireside associates and home companions have been

confined to the light literature just referred to—will such a youth, after leaving school undertake a course of reading which will require vigorous, independent, manly thought, and hard labour? It should never be forgotten by the teacher or the parent, that "man is a bundle of habits;" that the *habits* he forms during his school-days, are more important than any amount of *knowledge* he may there acquire.

Let then the youth early learn to study his book at home; and, during his whole pupilage, let him not, for a single day, be excused from the labour of preparing some exercise at the fireside. We may then hope that when he leaves school, he will not utterly forsake his studies; that, in his future intercourse with books, he will not be confined to those of a light and frivolous character; but that from *choice*, as well as from a sense of duty, he will cultivate the acquaintance of authors whose works are adapted to perfect the mental and moral training already so happily commenced.

The healthful *moral* influence of such evening exercises deserves a passing notice. The mind of youth is ever active. If not employed upon one thing it will be upon some other. If suitable employment be not provided for it, it will almost certainly seek employments which are unsuitable and degrading. How are our youth exposed to temptation, in consequence of having nothing at home to occupy and interest them? Whatever, therefore, we can do to furnish them with such occupation, especially whatever we do to form in them habits of home-study, and a love for substantial literature, is so much done to save them from the snare of him who

"finds some mischief still  
For idle hands to do."

How many a victim to vicious habits might have been saved to his family and friends, and to society, if suitable employment had, in his youthful days, been provided for him by his parents and teachers!

AFFECTIONS, like the conscience, are rather to be led than drawn; and it is to be feared they that marry, where they do not love, will love where they do not marry.—*Fuller*.



# POPULAR ASTRONOMY.

## LETTER XV.

### LONGITUDE.—TIDES.

"First in his east, the glorious lamp was seen  
Regent of day, and all the horizon round  
Invested with bright rays, jocund to run  
His *longitude* through heaven's high road; the gray  
Dawn and the Pleiades before him danced,  
Shedding sweet influence."—MILTON.

THE ancients studied astronomy chiefly as subsidiary to astrology, with the vain hope of thus penetrating the veil of futurity, and reading their destinies among the stars. The moderns, on the other hand, have in view, as the great practical object of this study, the perfecting of the art of navigation. When we reflect on the vast interests embarked on the ocean, both of property and life, and upon the immense benefits that accrue to society from a safe and speedy intercourse between the different nations of the earth, we cannot but see that whatever tends to enable the mariner to find his way on the pathless ocean, and to secure him against its multiplied dangers, must confer a signal benefit on society.

In ancient times, to venture out of sight of land was deemed an act of extreme audacity; and Horace, the Roman poet, pronounces him who first ventured to trust his frail bark to the stormy ocean, endued with a heart of oak, and girt with triple folds of brass. But now, the navigator who fully avails himself of all the resources of science, and especially of astronomy, may launch fearlessly on the deep, and almost bid defiance to rocks and tempests. By enabling the navigator to find his place on the ocean with almost absolute precision, however he may have been driven about by the winds, and however long he may have been out of sight of land, astronomers must be held as great benefactors to all who commit either their lives or their fortunes to the sea. Nor have they secured to the art of navigation such benefits without incredible study and toil, in watching the motions of the heavenly bodies, in investigating the laws by which their movements are governed, and in reducing all their discoveries to a form easily available to the navigator, so that, by some simple observation on one or two of the heavenly bodies, with instruments which the astronomer has invented, and prepared for his use, and by looking out a few numbers in Tables which have been compiled for him, with immense labour, he may ascertain the exact place he occupies on the surface of the globe, thousands of miles from land.

The situation of any place is known by its latitude and longitude. As charts of every ocean and sea are furnished to the sailor, in which are laid down the latitudes and longitudes of every point of land, whether on the shores of islands or the main, he has, therefore, only to ascertain his latitude and longitude at any particular place on the ocean, in order to find where he is, with respect to the nearest point of land, although this may be, and may always have been, entirely out of sight to him.

To determine the *latitude* of a place is comparatively an easy matter, whenever we can see either the sun or the stars. The distance of the sun from the zenith, when on the meridian, on a given day of the year, (which distance we may easily take with the sextant), enables us, with the aid of the Tables, to find the latitude of the place; or, by taking the altitude of the north star, we at once obtain the latitude.

The *longitude* of a place may be found by any method, by which we may ascertain how much its time of day differs from that of Greenwich at the same moment. A place that lies eastward of another comes to the meridian an hour earlier for every fifteen degrees of longitude, and of course has the hour of the day so much in advance of the other, so that it counts one o'clock when the other place counts twelve. On the other hand, a place lying westward of another comes to the meridian later by one hour for every fifteen degrees, so that it counts only eleven o'clock when the other place counts twelve. Keeping these principles in view, it is easy to see that a comparison

of the difference of time between two places at the same moment, allowing fifteen degrees for an hour, sixty minutes for every four minutes of time, and sixty seconds for every four seconds of time, affords us an accurate mode of finding the difference of longitude between the two places. This comparison may be made by means of a chronometer, or from solar or lunar eclipses, or by what it is called the lunar method of finding the longitude.

*Chronometers* are distinguished from clocks, by being regulated by means of a balance-wheel instead of a pendulum. A watch, therefore, comes under the general definition of a chronometer; but the name is more commonly applied to larger time-pieces, too large to be carried about the person, and constructed with the greatest possible accuracy, with special reference to finding the longitude. Suppose, then, we are furnished with a chronometer set to Greenwich time. We arrive at New York, for example, and compare it with the time there. We find it is five hours in advance of the New York time, indicating five o'clock, P. M., when it is noon at New York. Hence we find that the longitude of New York is  $5 \times 15 = 75$  degrees.\* The time at New York, or any individual place, can be known by observations with the transit-instrument, which gives us the precise moment when the sun is on the meridian.

It would not be necessary to resort to Greenwich, for the purpose of setting our chronometer to Greenwich time, as it might be set at any place whose longitude is known, having been previously determined. Thus, if we know that the longitude of a certain place is exactly sixty degrees east of Greenwich, we have only to set our chronometer four hours behind the time at that place, and it will be regulated to Greenwich time. Hence it is a matter of the greatest importance to navigation, that the longitude of numerous ports, in different parts of the earth, should be accurately determined, so that when a ship arrives at any such port, it may have the means of setting or verifying its chronometer.

This method of taking the longitude seems so easy, that you will perhaps ask, why it is not sufficient for all purposes, and accordingly, why it does not supersede the more complicated and laborious methods? why every sailor does not provide himself with a chronometer, instead of finding his longitude at sea by tedious and oft-repeated calculations, as he is in the habit of doing? I answer, it is only in a few extraordinary cases that chronometers have been constructed of such accuracy as to afford results as exact as those obtained by the other methods, to be described shortly; and instruments of such perfection are too expensive for general use among sailors. Indeed, the more common chronometers cost too much to come within the means of a great majority of seafaring men. Moreover, by being transported from place to place, chronometers are liable to change their *rate*. By the rate of any time-piece is meant its deviation from perfect accuracy. Thus, if a clock should gain one second per day, one day with another, and we should find it impossible to bring it nearer to the truth, we may reckon this as its rate, and allow for it in our estimate of the time of any particular observation. If the error was not uniform, but sometimes greater and sometimes less than one second per day, then the amount of such deviation is called its "variation from its mean rate." I introduce these minute statements (which are more precise than I usually deem necessary), to show you to what an astonishing degree of accuracy chronometers have in some instances been brought. They have been carried from London to Baffin's Bay, and brought back, after a three years' voyage, and found to have varied from their mean rate, during the whole time, only a second or two, while the extreme variation of several chronometers, tried at the Royal Observatory at Greenwich, never exceeded a second and a half. Could chronometers always be depended on to such a degree of accuracy as this, we should hardly desire anything better for determining the longitude of different places on the earth. A recent determination of the longitude of the City Hall in New York, by means of three chronometers, sent out from London expressly for that purpose, did not differ from the longitude as found by a solar eclipse (which is one of the best methods) but a second and a quarter.

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\* The exact longitude of the City Hall, in the City of New York, is 4h. 56m. 33.5s.



*Eclipses of the sun and moon* furnish the means of ascertaining the longitude of a place, because the entrance of the moon into the earth's shadow in a lunar eclipse, and the entrance of the moon upon the disc of the sun in a solar eclipse, are severally examples of one of those instantaneous occurrences in the heavens, which afford the means of comparing the times of different places, and of thus determining their differences of longitude. Thus, if the commencement of a lunar eclipse was seen at one place an hour sooner than at another, the two places would be fifteen degrees apart in longitude; and if the longitude of one of the places was known, that of the other would become known also. The exact instant of the moon's entering into the shadow of the earth, however, cannot be determined with very great precision, since the moon, in passing through the earth's penumbra, loses its light gradually, so that the moment when it leaves the penumbra and enters into the shadow cannot be very accurately defined. The first contact of the moon with the sun's disc, in a solar eclipse, or the moment of leaving it,—that is, the beginning and end of the eclipse,—are instants that can be determined with much precision, and accordingly they are much relied on for an accurate determination of the longitude. But, on account of the complicated and laborious nature of the calculation of the longitude from an eclipse of the sun, (since the beginning and end are not seen at different places, at the same moment,) this method of finding the longitude is not adapted to common use, nor available at sea. It is useful, however, for determining the longitude of fixed observatories. The *lunar method of finding the longitude* is the most refined and accurate of all the modes practised at sea. The motion of the moon through the heavens is so rapid, that she perceptibly alters her distance from any star every minute; consequently, the moment when that distance is a certain number of degrees and minutes is one of those instantaneous events, which may be taken advantage of for comparing the times of different places, and thus determining their difference of longitude. Now, in a work called the "Nautical Almanack," printed in London, annually, for the use of navigators, the distance of the moon from the sun by day, or from known fixed stars by night, for every day and night in the year, is calculated beforehand. If, therefore, a sailor wishes to ascertain his longitude, he may take with his sextant the distance of the moon from one of these stars at any time,—suppose nine o'clock, at night,—and then turn to the "Nautical Almanack," and see *what time it was at Greenwich* when the distance between the moon and that star was the same. Let it be twelve o'clock, or three hours in advance of his time: his longitude, of course, is forty-five degrees west.

This method requires more skill and accuracy than are possessed by the majority of seafaring men; but, when practised with the requisite degree of skill, its results are very satisfactory. Captain Basil Hall, one of the most scientific commanders in the British navy, relates the following incident, to show the excellence of this method. He sailed from San Blas, on the west coast of Mexico, and, after a voyage of eight thousand miles, occupying eighty-nine days, arrived off Rio de Janeiro, having, in this interval, passed through the Pacific Ocean, rounded Cape Horn, and crossed the South Atlantic, without making any land, or even seeing a single sail, with the exception of an American whaler off Cape Horn. When within a week's sail of Rio, he set seriously about determining, by lunar observations, the precise line of the ship's course, and its situation at a determinate moment; and having ascertained this within from five to ten miles, ran the rest of the way by those more ready and compendious methods, known to navigators, which can be safely employed for short trips between one known point and another, but which cannot be trusted in long voyages, where the moon is the only sure guide. They steered towards Rio Janeiro for some days after taking the lunars, and, having arrived within fifteen or twenty miles of the coast, they hove to, at four in the morning, till the day should break, and then bore up, proceeding cautiously, on account of a thick fog which enveloped them. As this cleared away, they had the satisfaction of seeing the great Sugar-Loaf Rock, which stands on one side of the harbour's mouth, so nearly right ahead, that they had not to alter their course above a point, in order to hit the entrance of the harbour. This was the first land they had seen for three months, after crossing so many seas, and being set back—

wards and forwards by innumerable currents and foul winds. The effect on all on board was electric; and the admiration of the sailor was unbounded. Indeed, what could be more admirable than that a man on the deck of a vessel, by measuring the distance between the moon and a star, with a little instrument which he held in his hand, could determine his exact place on the earth's surface in the midst of a vast ocean, after having traversed it in all directions, for three months, crossing his track many times, and all the while out of sight of land?

The lunar method of finding the longitude could never have been susceptible of sufficient accuracy, had not the motions of the moon, with all their irregularities, been studied and investigated by the most laborious and profound researches. Hence Newton, while rapt in those meditations which, to superficial minds, would perhaps have appeared rather curious than useful, inasmuch as they respected distant bodies of the universe which seemed to have little connection with the affairs of this world, was labouring night and day for the benefit of the sailor and the merchant. He was guiding the vessel of the one, and securing the merchandise of the other; and thus he contributed a large share to promote the happiness of his fellow-men, not only in exalting the powers of the human intellect, but also in preserving the lives and fortunes of those engaged in navigation and commerce. Principles in science are rules in art; and the philosopher who is engaged in the investigation of these principles, although his pursuits may be thought less practically useful than those of the artisan who carries out those principles into real life, yet, without the knowledge of the principles, the rules would have never been known. Studies, therefore, the most abstruse, are, when viewed as furnishing rules to act, often productive of the highest practical utility.

Since the *tides* are occasioned by the influence of the sun and moon, I will conclude this letter with a few remarks on this curious phenomenon. By the tides are meant the alternate rising and falling of the waters of the ocean. Its greatest and least elevations are called *high and low water*; its rising and falling are called *flood and ebb*; and the extraordinary high and low tides that occur twice every month are called *spring and neap tides*. It is high or low tide on opposite sides of the globe at the same time. If, for example, we have high water at noon, it is also high water to those who live on the meridian below us, where it is midnight. In like manner, low water occurs simultaneously on opposite sides of the meridian. The average amount of the tides for the whole globe is about two and a half feet; but their actual height at different places is very various, sometimes being scarcely perceptible, and sometimes rising to sixty or seventy feet. At the same place, also, the phenomena of the tides are very different at different times. In the Bay of Fundy, where the tide rises seventy feet, it comes in a mighty wave, seen thirty miles off, and roaring with a loud noise. At the mouth of the Severn, in England, the flood comes up in one head about ten feet high, bringing certain destruction to any small craft that has been unfortunately left by the ebbing waters on the flats; and as it passes the mouth of the Avon, it sends up that small river a vast body of water, rising, at Bristol, forty or fifty feet.

Tides are caused by the unequal attractions of the sun and moon upon different parts of the earth. Suppose the projectile force by which the earth is carried forward in her orbit to be suspended, and the earth to fall towards one of these bodies,—the moon, for example,—in consequence of their mutual attraction. Then, if all parts of the earth fell equally towards the moon, no derangement of its different parts would result, any more than of the particles of a drop of water, in its descent to the ground. But if one part fell faster than another, the different portions would evidently be separated from each other. Now, this is precisely what takes place with respect to the earth, in its fall towards the moon. The portions of the earth in the hemisphere next to the moon, on account of being nearer to the centre of attraction, fall faster than those in the opposite hemisphere, and consequently leave them behind. The solid earth, on account of its cohesion, cannot obey this impulse, since all its different portions constitute one mass, which is acted on



in the same manner as though it were all collected in the centre; but the waters on the surface, moving freely under this impulse, endeavour to desert the solid mass and fall towards the moon. For a similar reason, the waters in the opposite hemisphere, falling less towards the moon than the solid earth does, are left behind, or appear to rise.

But if the moon draws the waters of the earth into an oval form towards herself, raising them simultaneously on the opposite sides of the earth, they must obviously be drawn away from the intermediate parts of the earth, where it must at the same time be low water. Thus in fig. 44, the moon, M, raises the waters beneath itself at Z and N, at which places it is high water, but at the same time depresses the waters at H and R, at which places it is low water. Hence, the interval between the high and low tide, on successive days, is about fifty minutes, corresponding to the progress of the moon in her orbit from west to east, which causes her to come to the meridian about fifty minutes later every day. There occurs, however, an intermediate tide, when the moon is on the lower meridian, so that the interval between two high tides is about twelve hours, and twenty-five minutes.

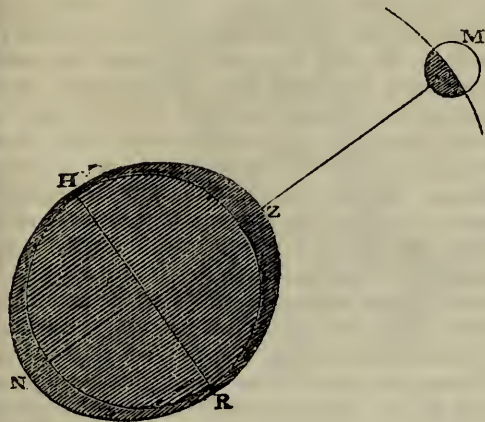


Fig. 44.

Were it not for the impediments which prevent the force from producing its full effects, we might expect to see the great tide-wave, as the elevated crest is called, always directly beneath the moon, attending it regularly around the globe. But the inertia of the waters prevents their instantly obeying the moon's attraction, and the friction of the waters on the bottom of the ocean still further retards its progress. It is not, therefore, until several hours (differing at different places) after the moon has passed the meridian of a place, that it is high tide at that place.

The sun has an action similar to that of the moon, but only *one third* as great. On account of the great mass of the sun, compared with that of the moon, we might suppose that his action in raising the tides would be greater than the moon's; but the nearness of the moon to the earth more than compensates for the sun's greater quantity of matter. As, however, wrong views are frequently entertained on this subject, let us endeavour to form a correct idea of the advantage which the moon derives from her proximity. It is not that her actual amount of attraction is thus rendered greater than that of the sun; but it is that her attraction for the *different parts* of the earth is very unequal, while that of the sun is nearly uniform. It is the *inequality* of this action, and not the absolute force, that produces the tides. The sun being ninety-five millions of miles from the earth, while the diameter of the earth is only one twelve thousandth part of this distance, the effects of the sun's attraction will be nearly the same on all parts of the earth, and therefore will not, as was explained of the moon, tend to separate the waters from the earth on the nearest side, or the earth from the waters on the remotest side, but in a degree proportionally smaller. But the diameter of the earth is one thirtieth the distance of the moon, and therefore the moon acts with considerably greater power on one part of the earth than on another.

As the sun and moon both contribute to produce the tides, and as they sometimes act together and sometimes in opposition to each other, so corresponding variations occur in the height of the tide. The *spring tides*, or those which rise to an unusual height twice a month, are produced by the sun and moon's acting together; and the *neap tides*, or those which are unusually low twice a month, are produced by the sun and moon's acting in opposition to each other. The spring tides occur at the

syzygies: the neap tides at the quadratures. At the time of new moon, the sun and moon both being on the same side of the earth, and acting upon it in the same line, their actions conspire, and the sun may be considered as adding so much to the force of the moon. We have already seen how the moon contributes to raise a tide on the opposite side of the earth. But the sun, as well as the moon, raises its own tide-wave, which at new moon coincides with the lunar tide-wave. This will be plain on

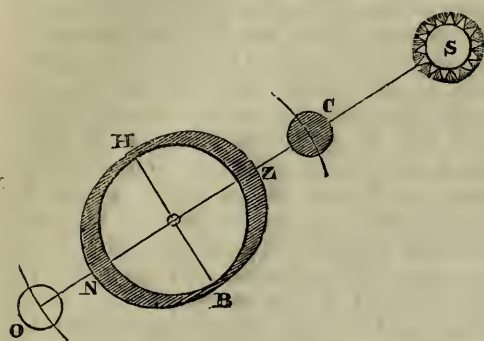


Fig. 45.

inspecting the diagram, Fig. 45, where S represents the sun, C, the moon in conjunction, O, the moon in opposition, and Z, N, the tide-wave. Since the sun and moon severally raise a tide-wave, and the two here coincide, it is evident that a peculiarly high tide must occur when the two bodies are in conjunction, or at new moon. At full moon, also, the two luminaries conspire in the same way to raise the tide; for we must recollect that each body contributes to raise a tide on the opposite side. Thus, when the sun is at S and the moon at O, the sun draws the waters on the side next to it away from the earth, and the moon draws the earth away from the waters on that side; their united actions therefore, conspire, and an unusually high tide is the result. On the side next to O, the two forces likewise conspire: for while the moon draws the waters away from the earth, the sun draws the earth away from the waters. In both cases an unusual low tide is produced; for the more the water is elevated at Z and N, the more it will be depressed at H and R, the places of low tide.

Twice a month, also, namely, at the quadratures of the moon, the tides neither rise

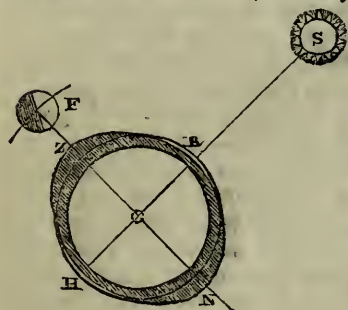


Fig. 46.

so high nor fall so low as at other times, because then the sun and moon act against each other. Thus, in Fig. 46, while F tends to raise the water at Z, S tends to depress it, and consequently the high tide is less than usual. Again, while F tends to depress the water at R, S tends to elevate it, and therefore the low tide is less than usual. Hence the difference between high and low water is only half as great at neap as at spring tide. In the diagrams, the elevation and depression of the waters is represented, for the sake of illustration, as far greater than it really is; for you must recollect that the average height of the tides for the whole globe is only about two and

a half feet; a quantity so small, in comparison with the diameter of the earth, that were the due proportions preserved in the figures, the effect would be wholly insensible.

The variations of distance in the sun are not great enough to influence the tides very materially, but the variations in the moon's distances have a striking effect. The tides which happen, when the moon is in perigee, are considerably greater than when she is in apogee; and if she happens to be in perigee at the time of the syzygies, the spring tides are unusually high.

The motion of the tide-wave is not a *progressive* motion, but a mere undulation, and is to be carefully distinguished from the currents to which it gives rise. If the ocean completely covered the earth, the sun and moon being in the equator, the tide-wave would travel at the same rate as the earth revolves on its axis. Indeed, the correct way of conceiving of the tide-wave, is to consider the moon at rest, and the earth, in its rotation from west to east, as bringing successive portions of water under the moon, which portions being elevated successively, at the same rate as the earth revolves on its axis, have a relative motion westward, at the same rate.



The tides of rivers, narrow bays, and shores far from the main body of the ocean, are not produced in those places by the direct action of the sun and moon, but are subordinate waves propagated from the great tide-wave, and are called *derivative* tides, while those raised directly by the sun and moon are called *primitive* tides.



Fig. 47.

The velocity with which the tide moves will depend on various circumstances, but principally on the depth, and probably on the regularity, of the channel. If the depth is nearly uniform the tides will be regular; but if some parts of the channel are deep while others are shallow, the waters will be detained by the greater friction of the shallow places, and the tides will be irregular. The direction, also, of the derivative tide may be totally different from that of the primitive. Thus, in Fig 47, if the great tide-wave, moving from east to west, is represented by the lines 1, 2, 3, 4, the derivative tide, which is propagated up a river or bay, will be represented by the lines 3, 4, 5, 6, 7. Advancing faster in the channel than next the bank, the tides will lag behind towards the shores, and the tide-wave will take the form of curves, as represented in the diagram.

On account of the retarding influence of shoals, and an uneven, indented coast, the tide-wave travels more slowly along the shores of an island than in the neighbouring sea, assuming convex figures at a little distance from the island, and on opposite sides of it. These convex lines sometimes meet, and become blended in such a way, as to create singular anomalies in a sea much broken by islands, as well as on coasts indented with numerous bays and rivers. Peculiar phenomena are also produced when the tide flows in at opposite extremities of a reef or island, as into the two opposite ends of Long-Island Sound. In certain cases, a tide-wave is forced into a narrow arm of the sea, and produces very remarkable tides. The tides of the Bay of Fundy (the highest in the world) are ascribed to this cause. The tides on the coast of North America are derived from the great tide-wave of the South Atlantic, which runs steadily northward along the coast to the mouth of the Bay of Fundy, where it meets the northern tide-wave flowing in the opposite direction. This accumulated wave being forced into the narrow space occupied by the Bay, produces the remarkable tide of that place.

The largest lakes and inland seas have no perceptible tides. This is asserted by all writers respecting the Caspian and Euxine; and the same is found to be true of the largest of the North American lakes, Lake Superior. Although these several tracts of water appear large, when taken by themselves, yet they occupy but small portions of the surface of the globe, as will appear evident from the delineation of them on the artificial globe. Now, we must recollect that the primitive tides are produced by the *unequal* action of the sun and moon upon the different parts of the earth; and that it is only at points whose distance from each other bears a considerable ratio to the whole distance of the sun or moon, that the inequality of action becomes manifest. The space required to make the effect sensible is larger than either of these tracts of water. It is obvious, also, that they have no opportunity to be subject to a derivative tide.

Although all must admit that the tides have *some connection* with the sun and the moon, yet there are so many seeming anomalies, which at first appear irreconcilable with the theory of gravitation, that some are unwilling to admit the explanation given by this theory. Thus, the height of the tide is so various, that at some places on the earth there is scarcely any tide at all, while at other places it rises to seventy feet.

The time of occurrence is also at many places wholly unconformable to the motions of the moon, as is required by the theory, being low water where it should be high water; or, instead of appearing just beneath the moon, as the theory would lead us to expect, following it at the distance of six, ten, or even fifteen hours; and finally the moon sometimes appears to have no part at all in producing the tide, but it happens uniformly at noon and midnight (as is said to be the case at the Society Islands), and therefore seems wholly dependent on the sun.

Notwithstanding these seeming inconsistencies with the law of universal gravitation, to which the explanation of the tides is referred, the correspondence of the tides to the motions of the sun and moon, in obedience to the law of attraction, is in general such as to warrant the application of that law to them, while in a great majority of the cases which appear to be exceptions to the operation of that law, local causes and impediments have been discovered, which modified or overruled the uniform operation of the law of gravitation. Thus it does not disprove the reality of the existence of a force which carries bodies near the surface of the earth towards its centre, that we see them sometimes compelled, by the operation of local causes, to move in the opposite direction. A ball shot from a cannon is still subject to the law of gravitation, although, for a certain time, in obedience to the impulse given it, it may proceed in a line contrary to that in which gravity alone would carry it. The fact that water may be made to run up-hill does not disprove the fact that it usually runs down-hill by the force of gravity, or that it is still subject to this force, although, from the action of modifying or superior forces, it may be proceeding in a direction contrary to that given by gravity. Indeed, those who have studied the doctrine of the tides most profoundly, consider them as affording a striking and palpable exhibition of the truth of the doctrine of universal gravitation.

*(To be continued.)*

## CHARACTER FOR THE YOUNG.

CHARACTER is everything to the young, as it is the surest means of success in life. It is better than the most ample fortune; it is better than the patronage of rich and powerful friends. A young person of established character, virtuous principles, of good conduct, though he be poor, and left to his own unaided efforts, will rarely fail to make a way for himself in the world. He may be assailed by misfortune; he may lose his health, or fall into adverse circumstances, and so be embarrassed and oppressed in his course; but as a general rule, it cannot be questioned that a fair character,—a character for intelligence, virtue, and worth,—is the surest pledge of success in life. For many years we have been accustomed to watch with great interest, the fortunes of the young in their progress in life; and long since have we come to the settled conclusion, that in so far as success is concerned, whether in the learned professions, or in the ordinary business of men, character, virtue, intelligence, a well regulated mind and heart, is of higher value than heirship to the richest estate, than all outward ad-

vantages whatever. Such an estate, such advantages, are apt to inflate with pride, to lead to imprudence, to idleness and vice; and where this is the case, it takes but a short time to squander a fortune and bar every door to respectability and happiness. But character, we repeat, never fails. It makes friends and subdues enemies, creates funds, opens the gates of opportunity, draws around its possessor patronage and support, makes him a sure and easy way to wealth, to honour, and to happiness.

ANECDOTE OF MACKLIN.—Macklin was exceedingly quick at a reply, especially in a dispute. One day Dr. Johnson was contending some dramatic question, and quoted a passage from a Greek poet in support of his opinion: "I don't understand Greek, though, doctor," said Macklin. "Sir," said Johnson, pompously, "a man who undertakes to argue should understand all languages." "Oh! very well," returned Macklin, "how will you understand this argument?" and immediately treated him to a long quotation in Irish.



## THE MIRROR OF NATURE.

*(Continued from page 197.)*

IRON is not so easily melted. To separate this, the most useful of all the metals from its ore, there is needed a greater and a long-continued heat in a furnace. Moreover, no metal came so often and so abundantly into the hands of man as this. For there are not only whole mountains, and even mountain ranges, almost entirely penetrated with iron ore, and extensive plains covered with beds of this same ore, but the iron, contained in sand-stones and basalt, spread out over hundreds of square miles, has been separated, here and there in masses, from the rich iron ore. That Providence, which is universally manifested in the gift of iron to all countries, inhabitable by man, is visible especially in this, that to those nations who possess the greatest activity and capacity for trade, it gives also the most abundant means for the exercise of their peculiar faculties. An example in point is given in the busy English, who are wonderfully rich in those metals, which are most serviceable to trade. For England alone produces sixty thousand cwt. of tin, more than twelve times as much as that produced by all the rest of Europe taken together, besides two hundred and fifty thousand cwt. of lead, more than half of the whole European produce; of copper, England produces two hundred thousand cwt.; of iron, a third of the whole amount produced by Europe; of calamine (carbonate of zinc), fifty thousand cwt.

The possession of such a treasure of useful metals, which one cannot take in his hand and put into his mouth like other gifts of a prolific soil, but which must be first wrought in various ways, in order to convert labour into money and money into bread, may indeed be adapted to awaken the powers and the activity of a people; much, nevertheless, depends upon the natural gifts and genius of a nation. For in how many countries, where there is want and starvation enough—as, for instance, in the Turkish dominions—do the richest treasures of useful materials lie all unused in the earth. But the English, of whose com-

mercial genius, abundant coal-mines come in aid, know so well how to put to use the iron which their own island yields, and which is brought to them in part from other countries, that the value of their steel and iron fabrics, may be estimated at one hundred and ninety-two millions of gilders yearly,—a sum of which the greater part goes to the capitalists, who advance the needed monies, and are the possessors of the factories, but of which, nevertheless, two hundred and seventy thousand operatives, employed in iron manufactures, have a share.

In England, and in other lands, in which the manufacture of iron is pursued with special success, it might seem as if dealing with this metal had an animating effect upon the industry of a people. And iron, of all the metals, may be said to stand next to life. For in iron, first of all, is manifested a motion of seeking and avoiding, of attracting and repelling, similar and akin to the rudimental phenomena of animal life. Iron, as a magnet, is capable of being affected by the force of a universal motion, like the animal when it yields to the power of instinct. Our art, although it combines substances now thus and now so, is not by any means able to generate from these substances such combined elements as are styled organic. Because the bodies of organised beings, plants and animals, are for the most part formed of them, we can produce no gelatine, no white of egg, no butter, and no cheese from the original substances, into which we separate the material world by analysis. Iron, however, encroaches in a slight degree upon the more exclusive domain of vital force, for the sediment obtained from cast iron, containing carbon, when dissolved in nitric acid by ammonia, gives, upon being boiled out in water, a mouldy kind of substance similar to that which comes at last from the dissolution of decayed plants and animals,—certainly only an approximation to the process of organic creation from elements, an approximation from the lowest, deepest step. But further, iron is seen, in yet another way, to stand in a nearer relation than the other metals to the processes of life: it enters as an actual and highly influential part into the blood of man and the more perfect

animals, and especially gives it its red colour.

All the substances thus far considered are easily known as metals proper, and were known as such to the Ancients. For many of them, gold, silver, platinum, quicksilver, copper, and even iron, at least in the here-and-there not inconsiderable masses in which it falls from the air, are found in a quite pure (metallic) state in Nature, as also bismuth, arsenic, antimony, &c. And even when these just named, and other metals strictly so called, are found, not pure, but as ores, combined with sulphur or some other metal, or as oxydes, united with the oxygen of the air, yet, according to the laws of ordinary chemical affinity, they may mostly without great difficulty be obtained in their peculiar metallic forms. Besides, all metals, in the strict sense, are distinguished by their specific gravity, which exceeds that of water at least five times. For, excepting titanium and tantalum, whose weight is not much over five times that of water, of the better known metals only arsenic and chromium are not quite six times the weight of that common measure. Tellurium and antimony not seven times; zinc, tin, bismuth and iron, not eight times; white manganese is more than eight; ladmium, molybdænum, cobalt, more than eight and a half; nickel and copper, almost nine; uranium, nine; silver, ten and a half; rhodium and palladium, over seventeen; gold, nineteen and a half; platinum and iridium, twenty-one to twenty-three times heavier than water.

*The prodigal poor man.*—The mention of gold-making in the foregoing chapter reminds me of an account of a man who indeed only wasted gold, he did not make it. But the old gold-makers, had they been distinctly aware of the how and the when of this waste, would not only have made a respectable profit for their pockets, but also have gained some important information in regard to their falsely celebrated art.

On the borders of C—lived a trader, of whom it may justly be said that he gave away in his lifetime more than many a rich count, more than the good bishop of —. And further, the man made his presents not in copper or silver, for these he did not readily give away for nothing, but

in pure gold. In his daily giving, like a magnanimous benefactor, who does not care to know what he is doing, he never looked to see in whose hands his gifts were placed, whether friend or foe, Christian or Jew, rich or poor, but he practised his liberality towards natives and foreigners, and especially was every one, who exchanged a crown with him, presented with a gift of gold.

My young readers will justly ask: Was the man then so rich, or was he only heedlessly prodigal?

I can affirm with truth that the trader was neither rich nor heedless, and that no one who ever knew him considered him a prodigal. On the contrary, he was accounted in his village, and the country round, a man, whose frugality rather exceeded than fell short of the right measure, and who, in matters of trade, where his interest was concerned, was rather over-cautious. The man was no gambler, nor drinker; into his house, or even into his mouth, there seldom went a glass of the cheapest French wine. For although he possessed a little vineyard, yet such was the quality of the grapes that he deemed it more advisable to sell them to the vinegar-makers, than to make a drink out of them for himself and his family. And so in other things, the economical trader spared as little as possible. He indulged neither himself nor his household in dress or in any expense in eating and drinking, for, as he often said, repeating an old proverb, "Fine bits make beggar's bags." His frugality was hardly to be blamed, for the man had a wife and eight children, and supported also his wife's parents, and from the income of his shop he could save nothing. Had the chests and boxes of the man, who in his lifetime had given away thousands of gilders in gold, been examined, the spare-penny, found there, would scarcely have amounted to a few hundreds.

All this sounds very singular, and yet there is something to be added more singular still. It appears as if, in the strange liberality of this trader, there was something very captivating for others; for all the people to whom he gave gold, gave it away again to other people, without making any use of it, until at last all these presents passed from hand to hand



into the royal mint, which gave the gold to nobody without an equivalent, but yielded a good profit to the government. Let me tell how the matter stood.

In an adjoining country little silver pieces had been coined, of the value of six and three kreutzers, which, when they had been for a long time in circulation, were distinguished by a quite peculiar colour. Perhaps the princes, whose impress these coins bore, wished their likenesses stamped thereon, to bear witness to their comfortable condition, for, instead of growing pale with age, these faces on the coins assumed a rosy-cheeked hue, like the hearty young fellows from the mountains, as blooming, as we say, as a Bavarian Johnny-cake. The art by which this rejuvenescence was accomplished consisted in this, that with the silver of these little coins somewhat more copper than usual was mixed; and as the world then as now, attached less value to the art and the likenesses than to the quality of the raw material of which the coins were made, the people of the neighbouring countries, and afterwards of the country itself, would no longer take the money at the value stamped upon it, and accordingly the six-kreutzer pieces fell to four, and the three-kreutzer pieces to two. Our trader, living on the borders, had been paid for his tobacco and snuff, for his coffee and sugar, almost entirely in these coins, and he himself bought again what he needed, with the same money. But when the time of its depreciation came, first in one country, and then in several others, the same profit was to be made by the exchanges which took place; and our tradesman, with others, took an active part in this exchange business, satisfying himself oftentimes with a very small profit. The good man did not know what a treasure passed through his hands, neither did the others guess it. Had they been aware of it, they were not in a situation to possess themselves of the hidden wealth, as the well instructed chemists afterwards did in the mint.

The case stood thus: those rosy-cheeked, so called silver coins, were after all not so much to be despised as people thought. For ordinary use in trade they had not indeed their professed value, and it was necessary that they should be withdrawn

from circulation; but the silver which was taken from them when they were re-coined at the mint, was found to contain, as is often the case with silver, and even copper, a portion of gold, which, in a large number of these coins, yielded no inconsiderable profit. The chemists went to work: they threw these coins broken up (granulated) into strong boiling sulphuric acid, and immediately it dissolved the silver and copper; but it had no effect upon the gold, which fell to the bottom as an unsightly black powder, and could be washed almost entirely pure out of the solution.

But how—what became of the silver? Was it lost? By no means, not a particle. The liquid was poured into leaden troughs, and so large a quantity of old copper added to it that the sulphuric acid was insufficient to dissolve it all. The sulphuric acid, which had united itself with the silver, instantly forsook it, and threw itself wholly on the copper; the silver, in a beautifully pure state, like the so-called native silver, was separated; the sulphuric acid, so far as the quantity used admitted, formed with the copper, blue vitriol, which yields an excellent colouring material, that stands at a pretty high value and price among our tradespeople.

There is much to be learned here, which may be made clear to the understanding by a very simple similitude. Water is standing in our fields, we dig a ditch, and the water, by its gravity, flows immediately into the ditch. Near the first, we dig a second ditch, and the water leaves the first and flows into the second. Thus a dozen ditches may be made, one deeper than the other, and the water will flow down into the deepest, and only return, when the deepest is full, and then it will fill the next deepest, and so on.

As the force of gravity affects the water and its motions, in a similar way the force of chemical attraction acts upon different substances. When iron and lead mixed with sulphur are melted together in a crucible, the sulphur immediately combines with the iron and forms sulphuret of iron. So long as a trace of the iron remains in the lead, not a particle of sulphur unites with the latter; only when all the iron is penetrated and taken up by the sulphur, does the sulphur that remains

combine with the lead and form sulphuret of lead.

As the sulphur operates in this case, so is it in the above-mentioned process of separating gold and silver by sulphuric acid. As a piece of wood, lying in the ditch, into which an opening has been made for the water to run in, is moved from its position by the water, and because it cannot sink is borne up upon the surface, so the gold is removed from its connection with the copper and silver by the sulphuric acid which falls into combination with the last-named substances. It is true this process of separation appears to the eye just the reverse of what takes place in the case of the piece of wood and the water, inasmuch as the wood is lifted from its resting-place at the bottom of the ditch and thrown upon the surface, while the gold in the liquid falls as a heavy powder to the bottom, instead of swimming on the top. But it is to be considered that in the department of what are called chemical attractions, we have to do with a power which ultimately indeed acts according to the same universal law as the mechanical action and reaction of gravity, but which nevertheless is of a quite other and different nature and origin, so that the phenomena which it calls forth oftentimes cross those which the differences of specific gravity, and which gravitation in general produces, and take a quite opposite direction.

As overflowing water pours itself over fields and meadows, so at first the sulphuric acid, heated to boiling, spreads itself over the metals susceptible of its influence. It dissolves the copper and the silver. But when the solution is put into leaden troughs, and copper is offered to the acid in abundance for its saturation, then we do as the farmer does, who digs a deep ditch to carry off the water which overflows his land. The sulphuric acid flows, with a downward pressing force, through all parts of the copper, and will dissolve the silver only when copper enough is not offered to it, with which it may combine.

We return once more to the consideration of the gold, which, in being separated from the two other metals in the solution, fell to the bottom. As after being washed out it presents itself to the eye as a black

powder, no one ignorant of the process that had taken place would hold it for what it is, for the precious metal, now retaining, of all its obvious qualities, only its gravity. Yet by a further exposure to fire it resumes its brilliancy and colour, as well as that cohesion of parts which fits it for being wrought in so many ways.

In our days every well-instructed goldsmith knows that, besides copper, in almost every piece of silver, which our mines produce, some gold is contained. The copper in this raw silver forms three-fifths, and sometimes one-half of the whole weight; the gold is indeed mostly only the one-thousandth, or the two-thousandth part of the weight of the silver. Nevertheless, such is the high value of gold, that this small proportion of gold is sufficient to pay the chemists for the trouble of purifying the silver from the copper; we receive back from them just as much silver and copper as we hand to them in plate or bars, the small quantity of gold which falls to the bottom in the solution serves to pay them for their trouble.

All this is now, as I have said, a well-known matter in our days. But if, a hundred or a hundred and fifty years ago, a chemist, full, as almost all chemists then were, of the chimera of making gold, had, by chemical agency, obtained such a black powder, becoming in his hand, upon further treatment, pure gold, he would have been not a little confirmed in the idea that one metal might be changed into another, that gold might be made out of copper by mixing the copper with a certain poisonous ingredient.

*The transmutation of the lower into a higher.*—Although I have spoken of the impossibility by any means yet known, of changing one metal into another, let me nevertheless relate a case to my young readers in which, instead of iron, copper at once appeared; and if they will go to the place, they may now, by the throw of a fisher's net, instead of an old rusty iron horse-shoe, have a beautiful bright copper one.

A miner, (so the story goes,) in ascending from a mine, dropped an iron scale, of Nuremberg manufacture, provided with a very exact division into inches, lines and tenths of lines. The poor man set a



special value upon it, as it had long been in his possession; but though he searched very carefully, it was not to be found. To all appearances it had fallen into the water in the mine. After some time the water was drawn off, and then the scale was found; but, strangely enough, it had become copper; and the same was the case with some of the nails originally iron, which were found upon the drawing off of the water. There was still water enough in the mine, the experiment was repeated, old iron horse-shoes, iron cups, and all kinds of articles made of iron, were thrown in, and after a time instead of a rusty iron horse-shoe, one of copper was drawn out, and the iron cups became copper ones. Who would not now agree with the Alchemists, and believe in the transmutation of one metal into another, of iron into copper?

And yet the case was quite otherwise, and quite as simple as the cases before mentioned. Water of such a kind, by depositing iron in which pure metallic copper is contained, is found in several places, particularly in Hungary near Neusohl. In general these waters are to be found where sulphuret of copper is obtained in abundance. For when the water flows over the scattered ore, or remains standing upon it, the sulphur and the copper combine with the oxygen gas (of which hereafter), and there is produced sulphate of copper (blue vitriol), which is dissolved in the water, which thereby receives a sharp taste (of verdigris). When iron is placed in this blue vitriol water, its stronger affinity for sulphuric acid immediately shows itself. The iron is dissolved in the sulphuric acid and water, and disappears from its place, which is filled by the copper in its perfectly pure metallic state. And because the place of every single particle of iron, as it goes into solution, is taken by a particle of copper, the copper in the main takes the shape which belonged to the metal which it dispossesses, although its surface is often very uneven, and its mass not uniformly thick.

We see here, therefore, not a transmutation of one substance into another, but only an exclusion of one metal by another. A metal, standing at a higher value, has put itself in the place of a more common and lower-priced metal, and the lower

metal has disappeared. In the spiritual world, such ennobling processes, by which a higher and better element of thought takes the place of a lower, are not unusual. In that invisible kingdom there are phenomena which bear witness to a real transmutation (transfiguration) of the low and the base into the high and the noble, for there reigns there a Spirit creating all things new, which works what and where it will.

*The metallic bases of the Alkalis and Earths.*—The abundance and universality of iron upon our earth and in its depths must arrest our attention. But there are yet other metallic bodies which present themselves, at least upon the surface of the earth, in masses beyond all proportion greater than those of all the metals strictly so called, put together.

Up to the commencement of this century, no student of Nature would have thought of regarding the so-called earths, such as *Lime*, *Magnesia*, *Barytes*, and *Alumina*, as anything else but elements or simple substances. The same may be said of the caustic *Alkalis*. When our chemists decomposed garnet into clay and silica, and into the oxides of iron and manganese, when, in Bohemian garnet, in addition to the just-named earths and metals, they found also lime and magnesia and chrome, they supposed that they had reached the last and deepest basis of the chemical composition of that stone. Of the possibility of a still further analysis of this substance no one dreamed. In addition to the previously known earths, there had also been discovered in the emerald and beryl, *Glucina*, in a hyacinth, *Zirconia*, in strouite, *Strontia*, and in some other kinds of stones, *Yttria* and *Thorina*, and a new alkali, *Lithia*, had been distinguished; and all these, just as lime and alumina, were held to be simple elements. In the year 1807, by the discoveries of a great English chemist, Sir Humphrey Davy, a gate was opened through which a deep glance might be cast into the secret nature of substances. These apparent or real substances are throughout nothing but polarizations of matter, through a natural power which is kindred to that of life, and even one with it. As life itself, so also a use of this natural power is given to man, in a certain measure, espe-

cially in electro-magnetical agencies; among which, as we shall see in the sequel, belongs galvanism. The one pole of a voltaic pile, which on this account may be designated as the acid pole, everywhere brings forth the substance of all substances, oxygen gas, from its concealment; the other pole makes apparent the peculiar opposite (the base), which, just in the particular material body under examination, has associated itself as an external body to the oxygen, that universal centrum of material existences. When, therefore, the usual metallic oxides are exposed to the influence of the two poles of a voltaic pile, there appears at one pole the metal in its pure, so-called elementary form.

A combination of potassa with water, was exposed by Davy to the action of a very strong voltaic pile, and immediately the supposed simple substance was polarised or decomposed; at one pole of the pile (the negative) appeared a brilliant metal, Potassium. In a similar way a metallic base has been disclosed in the two so-called fire-proof Alkalis,—the vegetable and the mineral alkalis; and likewise in lime, magnesia, barytes, strontia and alumina—in a word, in all the above mentioned earths and alkalis; so that now all those supposed elements appear as oxides; (metallic combinations with oxygen); and indeed tin-stone, magnet iron stone, and red iron stone, or blood-stone, according to their external character, are also oxides, peculiar in this, that, in their case, the oxygen gas incorporates itself with its metallic bases in a way in which the combination could not take place with any of the metals described at page 167, *et seq.* For among the metals proper, a considerable difference is to be found in that some of them, as platinum, gold, silver, mercury, iridium, palladium, rhodium, take the oxygen gas, by combination with which they become oxides, not only with great difficulty, but they give up again this association, when forced to it by human art, and let the oxygen gas go, when they are exposed to only a moderate heat, which, with most of them, does not need to be a red heat, much less a melting one. On the other hand, nickel must be subjected to the heat of a porcelain furnace, in order to set its oxygen at

liberty, and, in other cases, some other dainty must be offered to this winged, airy guest, to induce it to forsake its combination with the metal. In many cases, carbon suffices for this purpose. When carbon is brought into contact with the red hot metallic oxides, the oxygen naturally manifests a greater affinity for the combustible carbon than for the mere oxydisable metal. In the case of the oxides, however, the oxides of Tantalum, for instance, it is not enough to bring the red hot metallic oxide into contact with pulverised coal; a still greater degree of chemical polarisation is required to overcome the affinity of the oxygen for the metal.

But Tantalum and Titanium approach also the metallic bases of the earths, in that they are much lighter than the other metals strictly so called. And in a still higher measure is this the case with the metals of the earths and the alkalis.

A few years ago it would have been an occasion of ridicule had any one ventured to conjecture that there are several metals which are lighter than water, and can float on it like wood. The idea of a metal thus light was so entirely contradictory to the early and established notions which men entertained of metals, that one would have been disposed beforehand to deny a metallic nature to the light bases of the earths and alkalis. But it could not be questioned, when one considered *Calcium* or *Potassium*, or any other body of this kind. The silver or tin-white colour, which some of them possess, the metallic brightness which they all have in a greater or less degree, the property which belongs to them of combining (amalgamating) with quicksilver, or with a metal of their own family, and even with antimony, tin, bismuth and lead, their fusibility, and, in some, their malleability, testifies too plainly to their metallic nature.

(To be continued.)

SORROW.—Sorrow is the night of the mind. What would be a day without its night? The day reveals one sun only; the night brings to light the whole of the universe. The analogy is complete. Sorrow is the firmament of thought and the school of intelligence.



## REVIEW.

UNCLE TOM IN ENGLAND; OR, A PROOF THAT BLACK'S WHITE. *Houlston and Stoneman, Paternoster-row.*

THAT species of writing is always the best, which is most suitably adapted to the subject of which it treats. A fervid narrative, interspersed with vivid descriptions of scenery, is always attractive; and if heightened by the realities of natural and spirited representations of real conversations; exhibiting the characters of the several speakers, and, at the same time, suiting to the character of each, that peculiarity of thought and expression which distinguishes one from the other, then it becomes, as it were, a living reality in which the reader, almost unconsciously, feels himself to be taking a part. Such is the work before us, which we find, within the compass of a fortnight after publication, to have realized the astonishing sale of nearly TEN THOUSAND copies! Although such a sale is not always a test of excellence, yet it must speak immensely in favour of any production, and will, of itself, in every mind be a great inducement to see what it contains. The design of the book is to pourtray the iniquitous practices carried on by the Slave-holders in the Southern States of America; to show the baleful influences of Slavery itself; to hold up to detestation the enormity of its inhuman perpetrations, and to excite in the universal heart of mankind an utter abhorrence of the traffic, and a proportionate zeal to try to crush it for ever. Such are the objects of the work, we are bound to say, carried out with a fervour of spirit which hurries us along from the first scene to the last, as with the rush of a torrent. Did our space permit, we would cite several passages as remarkable for their truthfulness to nature, as the beauty with which they are told. This, however, must not be; but we cannot help referring to the eloquent and powerful defence made by Uncle Tom—the Black hero of the piece—when put upon his trial for endeavouring his escape. We well remember how our school-boy days used to be tortured, by having to learn, by heart, some piece of rubbish, selected from the English collection books, against an examination-day.

Gracious Heaven! what did we not suffer, when studying by every means in our power, before that dreaded day, some piece of the Master's selection dignified with the name of eloquence, and which was to gain us a prize! The very recollection makes us shudder at this moment. We think we now see ourselves delivering with all the elocution at our command, what we could not comprehend, and consequently, never could feel. Had we had a piece such as this defence of Uncle Tom's set us for our task, we would not only have committed it in a tenth of the time, but have felt its proper emphases without the necessary drilling to acquire this, from the Teacher,—who, by the way, deemed himself no subaltern in his office. Were Uncle Tom's Defence, or rather appeal, now introduced in the recitation-books of our schools, we believe it would have the twofold laudable effect of not only enduing the juvenile mind with the love of a rational liberty; but at the same time, helping the Anti-slavery society to eradicate all remembrance of the heart having ever been stained by such an inglorious traffic.

The passage we have selected is the following, which scarcely gives a fair idea of the Author's manner; but is introduced as more suitable for our pages than many others, and as showing how Tom, *the Black*, receives further tutoring, towards his struggle for freedom, from his wife Susan, mingled with those endearments which even can illumine the life of a slave:—

“So! Mr. Harris has bought you for his slave? Not contented with the wife, he must have the husband too, and make them the witnesses of each other's woes.”

“Iss, Susie, but he doan't know dat I'm your hushan'. He ask me some questions at de big room, but I tink he no heed what I say. For when I tole him I had a wife an' a chile tare away from me a long while ago, he made no observation, but tell me stan' up, and turn roun', an' do dis, an' do dat,—I sure he no know how much I lub you, Susie,” said he, turning and giving her a kiss.

“Nor must he know. It would destroy all our chance of happiness if he once discovered our relation, or that we even sympathised with each other. It is a part

of his 'discipline' to have no love between his slaves. 'Love is a stranger to his own heart, and he cannot tolerate it in us, whom he looks upon as brutes made merely to labour for his gain.'

"Hollo!" says Tom, "wat dat?" as something came frisking by him, and jumping up against Susan's face.

"Ah! Wallace! good Wallace! 'This has been my best friend here, Tom, my inseparable companion. But for him, my days and nights would have been wretched. I have found it a great joy' to have even one being to love me, and myself to love! even this good dog;" and she pulled his ears as he jumped around her, and licked her face.

"But you lub de good God, 'Susie, more than de dog?" said Tom, with an earnest intonation.

"Love him! how can I fail to love him? Is he not my Father, my Maker, and my God? Should I not have sunk into the grave long, long ago, but for the hope which His name shed around my heart? Have I not, when no one else dared to speak to me, heard His voice in the winds, whispering of heaven? Have I not, even when the cruel task-master has tied me to a rack, and lacerated my poor flesh, looked up and found God smiling down upon me? And do I not know that wherever my Emmeline is, God will be her protector? Yes, I love my God with all my heart and soul! But we need love on earth, as well as in heaven. The body as well as the spirit, needs caressing. We want to feel that there is something near that is dear to us,—we want to have some heart throbbing against our own,—some eye gazing upon us, and beaming forth with the sweet sentiment of love. And I have learned to love this dog, as the only friend left me."

Tom looked into his wife's face, as it beamed with poetic inspiration, and he felt that the love of years had all come back to his heart, and found intense expression in a moment. The dog having hitherto watched her, seemingly conscious that she was speaking of him, lowered his fine head to the grass, and then, scampering off to play with the children who were plucking flowers at a short distance, withdrew from a conversation so flattering to himself.

"Even master has been envious," she

said, "of the love that dog bears me; and more than once he chained him up, because, in coming from the cotton-fields, he would help to drag my sack along. But the poor creature pined away when kept away from me, and so master let him go."

"Wallace! Wallace!" shouted Tom, adding a shrill whistle, and Wallace came scampering back. Tom patted his long ears, and said, "Bless you, Massa Walley, you good kine dog to take care of Susie," in return for which compliment Wallace dashed his broad tongue against Tom's face, gave Susie a gentler salutation, and then scampered off to the children again, as if he really could not stand so much flattery.

"Now be sure, Tom, that in no moment of indiscretion you let any one know that I am your wife, or that you love me in the least."

"Dat's berry hard, 'Susie."

"'Tis harder to be discovered, or be torn asunder again, and all hope of happiness cut off."

"Dat's true, Susie, ebery word; gib me anoder kiss?" Tom helped himself,

"Besides," continued Susan, "who knows but if we get our liberty,"—and here she looked cautiously around, and spoke in a tremulous voice—"we may yet find our dear Emmeline?"

"Liberty! Emmeline!—but how, Susie? You would n't run away from your massa?"

"Would n't I?" and every muscle of her face moved with emotion. "This night! this moment? if the chances were in my favour, I would fly from him, and call upon God to help me!"

"But, Susie, God say, in de great book, 'Let as many servants as are under the yoke count their own masters worthy of all honour, that the name of God and his doctrine be not blasphemed. And they that have believing masters, let them not despise them, because they are brethren; but rather do them service, because they are faithful and beloved, partakers of the benefit. These things teach and exhort.'"

"Ah, Tom, but the Bible is not alone a master's book. Does it not say, 'Masters, give unto your servants that which is just and equal, knowing that ye also have a Master in heaven?' Does it not also say to servants, 'Be not as men-pleasers, but as the servants of Christ, doing the will of



God from the heart?' Does it not say, too, 'Ye masters do the same things unto them, forbearing threatening, knowing that your Master also is in heaven; neither is there respect of persons with Him?' And, further—'Whatsoever ye would that men should do unto you, do ye even so unto them?'"

"Dat's all true, ebry word. But the good Book say, 'Render unto Cæsar the things which are Cæsar's.' Now, if massa buy me, I am massa's, and no right to run away."

"But *who had a right to sell you, Tom? Who a right to steal you away from your father and mother? Who a right to steal me from you?—and to rob us of our dear Emmeline, our only child?*"

"I see!" said Tom. "No! I don't see!" and, with a look of considerable bewilderment, he pulled out his tattered, but still blessed book.

"Tom, does the Bible, anywherc, *give men the right to do wrong—to steal, to torture, to deny the light of the Gospel, to covet their neighbour's goods, and to set their hearts upon the treasures of the earth, to the ruin of the immortal souls of men?*"

"No! no!" exclaimed Tom; "noware, noware!" and he dashed over the pages with such rapidity that some of the loose fragments dropped out. Picking them up as so many bits of gold, and finding out by his intimate knowledge of the book the places to which they belonged, he said—"Go on, Susie; I like to hear you talk; to nie the blessed book seems more blessed now!"

"Well, then, Tom, know this. I have long been resolved upon obtaining my *liberty, my right*. The only scruple I have had has been the knowledge that I leave behind me some poor wretches to whom I have been a comfort. I have some books with me, which I have been in the habit of reading to them, and they have found water for their thirsty souls. I have 'The Life of Franklin,' 'The Life of Washington,' a part of 'Milton's' works, some of 'Shakspeare's,' the 'Life of William Penn,' the 'Life of Howard,' the 'Life of Gustavus Vasa,' the 'Narratives' of 'Pennington,' of 'Douglass,' and of 'Phillis Wheatley.'"

"Why, Susie," said Tom, "you mus' have all de books in de worl'?"

"I've a good many," she said, "but there must be an immense number more. They have taught me to know myself; to feel that I must live for a purpose, and by all Christian means, such as Christ's example suggests; that I must do my utmost for myself and my oppressed fellow-creatures, and thus promote the honour and the glory of God. And you will help me; won't you, Tom?"

"Iss," said Tom; "by de help ob God, I will!"

"That's a good boy," said she, patting his face, at which Tom was excessively pleased.

"And first," said Susan, "I shall begin my mission upon you, and teach you to speak well and correctly, that our means of doing good may be increased when we shall escape. We will look upon this as our school, and when the other hands are asleep, I shall come and talk to you, and you shall read to me. And I shall teach you to say *yes* instead of *iss*; and *they* instead of *dey*; and *there* instead of *thar*; and *well* instead of *wall*; and *always* instead of *ollers*; and many other little faults shall be corrected."

Tom looked down somewhat abashed. He thought that he spoke very nicely, and he didn't like Susie to discover defects in him.

So she patted him under the chin, and said to him, "Come, Tommy, no vain-glorying; you know, 'He that humbleth himself shall be exalted,'" and after a moment he was in an extremely good mood, and adopted her as his teacher.

"I will show you," said she, "what may be accomplished:—Phillis Wheatley was a poor negress, stolen from Africa, and sent to Boston; she was brought there by a lady who was as good to her as my dear mistress was to me. She learned to read and write, as I have already done: she went to England,—a beautiful country, where there are people of great minds and noble hearts, and where men and women are not bought and sold,—and there she was treated as a child of God without reference to the colour of her skin. She wrote these beautiful words, which I will now recite. They are upon

#### THE PROVIDENCE OF GOD.

Arise, my soul, on wings enraptured rise,  
To praise the Monarch of the earth and skies;

Whose goodness and beneficence appear,  
As round its centre moves the rolling year;  
Or when the morning glows with rosy charms,  
Or the sun slumbers in the ocean's arms :  
Of light Divine be a rich portion lent  
To guide my soul, and favour my intent.  
Celestial muse, my arduous flight sustain,  
And raise my mind to a seraphic strain!

Adored for ever be the God unseen,  
Which round the sun revolves this vast machine,  
Though, to His eye, its mass a point appears :  
Adored the God that whirls surrounding spheres,  
Who first ordain'd that mighty Sol should reign,  
The peerless monarch of the ethereal train.

\* \* \* From Him the extended earth  
Vigour derives, and every flowery birth ;  
Vast through her orb she moves with easy grace  
Around her Phœbus in unbounded space ;  
True to her course the impetuous storm derides,  
Triumphant o'er the winds and surging tides.

Almighty! in these wondrous works of thine  
What power, what wisdom, and what goodness  
shine!

And are thy wonders, Lord, by men explored,  
And yet creating glory unadored?  
Creation smiles in various beauty gay,  
While day to night, and night succeeds to day :  
The wisdom which attends Jehovah's ways  
Shines most conspicuous in the solar rays ;  
Without them, destitute of heat and light,  
This world would be the reign of endless night.

\* \* \* \* \*  
Hail! smiling morn, that from the orient main  
Ascending dost adorn the heavenly plain.  
So rich, so various are thy beauteous dyes  
That spread through all the circuit of the skies,  
That full of thee my soul in rapture soars,  
And thy great God, the cause of all, adores.  
O'er beings infinite his love extends,  
His wisdom rules them and his power defends :  
When tasks diurnal tire the human frame,  
The spirits faint, and dim the vital flame,  
Then too, that ever active bounty shines,  
Which not infinity of space confines.  
The sable veil that night in silence draws,  
Conceals effects, but shows the Almighty cause ;  
Night seals in sleep the wide creation fair,  
And all is peaceful but the brow of care.  
Again, gay Phœbus, as the day before,  
Wakes every eye, save what shall wake no more :  
Again the face of Nature is renew'd,  
Which still appears harmonious, fair, and good.  
May grateful strains salute the smiling morn,  
Before its beams the eastern hills adorn!  
Shall day to day and night to night conspire  
To show the goodness of the Almighty Sire?  
This mental voice shall man regardless hear,  
And never, never raise the filial prayer?

But see the sons of vegetation rise,  
And spread their leafy banners to the skies;  
All-wise, Almighty Providence we trace  
In trees, and plants, and all the flowery race,  
As clear as in the nobler frame of man,  
All lovely ensigns of the Maker's plan.  
The power the same that forms a ray of light,  
That call'd creation from eternal night.  
"Let there be light!" He said; from his profound  
Old Chaos heard, and trembled at the sound :  
Swift as the word, inspired by power Divine,  
Behold the light around its Maker shine,

The first fair product of the omnific God!  
And now, through all His works, diffused abroad.  
As reason's powers by day our God disclose,  
So may we trace Him in the night's repose.  
Say, what is sleep? and dreams—how passing  
strange!  
When action ceases, and ideas range  
Licentious and unbounded o'er the plains  
Where fancy's queen in giddy trixmph reigns.

Hear in soft strains the dreaming lover sigh  
To a kind fair, and rave in jealousy;  
On pleasure now, and now on vengeance bent,  
The labouring passions struggle for a vent.  
What power, oh man! thy reason then restores,  
So long suspended in nocturnal hours?  
What secret hand restores the mental train,  
And gives improved thine active powers again?  
From thee, oh man! what gratitude should rise!  
And when, from balmy sleep, thou op'st thine  
eyes,

Let thy first thoughts be praises to the skies.  
How merciful our God, who thus imparts  
O'erflowing tides of joy to human hearts,  
When wants and woes might be our righteous lot,  
Our God forgetting, by our God forgot!

\* \* \* \* \*  
Among the mental powers a question rose,  
"What most the image of the Eternal shows?"  
When thus to Reason (so let Fancy rove)  
Her great companion spoke. immortal Love:—  
"Say, mighty power, how long shall strife pre-  
vail,

And with its murmurs load the whispering gale?  
Refer the cause to Recollection's shrine,  
Who loud proclaims my origin Divine!  
The cause whence heaven and earth began to be;  
And is not man immortalized by me?  
Reason, let this most causeless strife subside."  
Thus Love pronounced, and Reason thus replied:  
"Thy birth, celestial queen! 'tis mine to own,  
In thee resplendent is the Godhead shown;  
Thy words persuade, my soul, enraptured, feels  
Resistless beauty which thy smile reveals."  
Ardent she spoke, and kindling at her charms,  
She clasp'd the blooming goddess in her arms.

Infinite love, where'er we turn our eyes,  
Appears: this every creature's want supplies;  
This most is heard in Nature's constant voice,  
This makes the morn, and this the eve rejoice;  
This bids the fostering rains and dews descend  
To nourish all, to serve one general end,  
The good of man; yet man ungrateful pays  
But little homage, and but little praise.  
To Him whose works array'd with mercy shine,  
What songs should rise, how constant, how  
Divine!"

Tom had listened to each syllable of  
every word. To him the beautiful lines,  
made more attractive by the sweet voice of  
Susan, appeared more musical than any-  
thing he had ever heard out of the Bible.  
"Did a poor negress write those lubly  
words?" said Tom.

"Those lovely—not lubly words," said  
Susan.

"Those *luv-e-ly* words," tried Tom.



"Lovely, not luv-e-c-ly words," said Susan.

"Lovely words."

"There, that's capital. Yes, Tom; and what's more, she wrote them when only eighteen years of age. So, you see, Tom, we may do something for our race yet."

"An', please God, we will!" said Tom.

Such is a brief sketch from UNCLE TOM IN ENGLAND, which has in Britain, already, been so widely circulated, and which we should be happy to hear of being as extensively read on Continental America, as Liberty there ought to be diffused.

### GLEANINGS.

ÆSCULAPIUS invented the probe. By means of æther, water can be made to freeze in summer. Augustus Cæsar established lending-houses. Basins were formerly used instead of mirrors. Bladders were used by the Romans to preserve their hair during the night. Chemical names of metals were first given to the heavenly bodies. There has been an instance of an elephant that walked upon a rope. (See Suetonius.) Fuller's earth was used by the ancients for washing. The streets of Rome have no lights, but those placed before the images of saints. Mahomet IV. was very fond of the ranunculus. The duke of Mantua is said to have had, in his possession, a powder which would convert water instantaneously into ice even in summer. The Greeks and Romans kept servants, whose duty it was to announce certain periods of the day. Ancient watchmen carried bells. Porus, an Indian king, sent to Augustus a man without arms, who with his feet could bend a bow and discharge arrows. Printers originally endeavoured to make the books they printed resemble manuscripts. Puppets were employed formerly to work miracles. Chinese puppets put in motion by means of quicksilver. The Roman ladies dyed their hair with plants brought from Germany. Saltpetre is used by the Italians for cooling wine. Thomas Schweicker wrote and made pens with his feet. Soap was invented by the Gauls, used by the Roman ladies as a pomade. Boiled water is said to freeze sooner than unboiled. Wildman taught bees to obey

his orders. The Greek and Roman physicians prepared their own medicines. Gustavus Erickson, king of Sweden, when he died, had no other physicians with him than his barber, master Jacob; an apothecary, master Lucas; and his confessor, magister Johannes. The scales of bleak are used for making artificial pearls. King Charles II. invited to England Brower, a Fleming, to improve the art of dyeing scarlet. Buckwheat was not known to the ancients; brought from the north of Asia into Europe about the beginning of the sixteenth century: sows itself in Siberia, for four or five years, by the seed that drops. Butter was known to the Scythians: called by Hippocrates *pikieron*: eaten by the Thracians at the wedding entertainment of Sphicrates: used by the Lusitanians instead of oil: Pliny ascribes its invention to the Germans. The Carthaginians had the first paved streets. Chimneys are not to be traced at Herculaneum. Dogs in Kamtschatka have socks upon their feet to preserve them from the snow. Saint Elizabeth the inventress of Hungary water. Fowls are said to thrive near smoke. Honey was used by the ancients for preserving natural curiosities. Smoke-jacks are of high antiquity. The transformation of insects was little known to the ancients. Justin, emperor of the West, was so ignorant, that he could not write without his secretary guiding his hand. The kitchens of the ancients were insufferably smoky. The streets of London were not paved in the eleventh century. Quarantine was first established by the Venetians. The ancients wrote with reeds. Rolender sent the cochineal plant, with live insects on it, to Linnæus, at Upsal. The first mention of horse-shoes is in the works of the Emperor Leo. The first account of stirrups is to be found in a book written by the Emperor Mauritius, on the "Art of War." Emperors and kings formerly held the stirrups when priests mounted their horses. The windows of the ancients had no glass. The use of quills is said to be as old as the fifth century. Reeds continued long in use after quills began to be employed; quills were so scarce at Venice in 1433, that it was with great difficulty men of letters could procure them.

## JOHN JAMES AUDUBON.

JOHN JAMES AUDUBON, the celebrated naturalist, was born in Louisiana, about the year 1782. He was of French descent, and his parents possessed that happy nature which disposed them to encourage the indication of genius and talent that they early perceived in the mind of their son.

In the preface to the first edition of his "Ornithology," from which we make extracts, Mr. Audubon has himself beautifully described his early life, and the parental care which was instrumental in leading him to acquire such a deep love of Nature.

"When I had hardly learned to walk, and to articulate those first words always so endearing to parents, the productions of nature that lay spread all around were constantly pointed out to me. They soon became my playmates; and before my ideas were sufficiently formed to enable me to estimate the difference between the azure tints of the sky and the emerald hue of the bright foliage, I felt that an intimacy with them, not of friendship merely, but bordering on frenzy, must accompany my steps through life. And now, more than ever, am I persuaded of the power of those early impressions. They laid such hold of me, that when removed from the woods, the prairies, and the brooks, or shut up from the view of the wide Atlantic, I experienced none of those pleasures most congenial to my mind.

"My father generally accompanied my steps, procured birds and flowers for me, and pointed out the elegant movements of the former, the beauty and softness of their plumage, the manifestations of their pleasure or their sense of danger, and the always perfect forms and splendid attire of the latter. He would speak of the departure and return of birds with the season, describe their haunts, and, more wonderful than all, their change of livery; thus exciting me to study them, and to raise my mind toward their great Creator.

"A vivid pleasure shone upon those days of my early youth, attended with a calmness of feeling that seldom failed to rivet my attention for hours, while I gazed with ecstasy upon the pearly and shining

eggs, as they lay embedded in the softest down, or among dried leaves and twigs, or were exposed upon the burning sand, or weather-beaten rock of our Atlantic shore. I was taught to look upon them as flowers yet in the bud.

"I grew up, and my wishes grew with my form. I was fervently desirous of becoming acquainted with nature. I wished to possess all the productions of nature, but I wished life with them. This was impossible. Then, what was to be done? I turned to my father, and made known to him my disappointment and anxiety. He produced a book of *Illustrations*. A new life ran in my veins. I turned over the leaves with avidity, and, although what I saw was not what I longed for, it gave me a desire to copy nature. To nature I went, and tried to imitate her.

"How sorely disappointed did I feel, for many years, when I saw that my productions were worse than those which I ventured to regard as bad in the book given me by my father. My pencil gave birth to a family of cripples. So maimed were most of them, that they more nearly resembled the mangled corpses on a field of battle, than the objects which I had intended them to represent.

"These difficulties and disappointments irritated me, but never for a moment destroyed the desire of obtaining perfect representations of nature. The worse my drawings were, the more beautiful did I see the originals. To have been torn from the study, would have been as death to me. My time was entirely occupied with it. I produced hundreds of these rude sketches annually, and for a long time, at my request, they made bonfires on the anniversary of my birthday."

In his sixteenth year, young Audubon was sent to France, to pursue his education. While there he attended schools of natural history and the arts, and took lessons in drawing from the celebrated David. Although he prosecuted his studies zealously, his heart still panted for the sparkling streams of his "native land of groves."

He returned in his eighteenth year, with an ardour for the woods, and soon commenced a collection of drawings, which have since swelled into a series of magnificent volumes—"The Birds of



America." These designs were begun on the farm given him by his father, situated near Philadelphia, on the banks of the Schuylkill.

There, amid its fine woodlands, its extensive fields, its hills crowned with evergreens, he meditated upon his simple and agreeable objects, and pursued his rambles, from the first faint streaks of day until late in the evening, when, wet with dew, and laden with feathered captives, he returned to the quiet enjoyment of the fireside. There, too, he was married, and was fortunate in choosing one who animated his courage amid vicissitudes, and in prosperity appreciated the grounds and measures of his success.

For many years the necessities of life drove him into commercial enterprises, which proved unsuccessful. His love for the fields and flowers, the forests and their winged inhabitants, unfitted him for trade. His chief gratification was derived from observation and study. His friends strove to wean him from his favourite pursuits, and he was compelled to struggle against the wishes of all, except his wife and children. They alone encouraged him, and were willing to sink or swim with the beloved husband and father. At length he gave himself entirely to observation and study of the feathered inhabitants of the forest.

He undertook long and tedious journeys; he ransacked the woods, the lakes, the prairies, and the shores of the Atlantic; he spent years away from his family. "Yet, will you believe it," says he, "I had no other object in view than simply to enjoy the sight of nature? Never for a moment did I conceive the hope of becoming, in any degree, useful to my fellow beings, until I accidentally formed an acquaintance with Charles Lucien Bonaparte, at Philadelphia, on the 5th of April, 1824."

It was soon afterwards that Bonaparte, having examined Audubon's large collection of beautiful drawings, and observed his extensive knowledge of birds, said to him, "Do you know that you are a great man?" In reply, Mr. Audubon asked him his intention of making such a remark. "Sir," answered Bonaparte, "I consider you the greatest ornithologist in the world." He then suggested to him the

importance of collecting and offering to the public the treasures which he had amassed during his wild journeyings.

This idea seemed like a beam of new light to Audubon's mind, and added fresh interest to his employment. For weeks and months he brooded over the kindling thought. He went westward to extend the number and variety of his drawings, with a view of preparing for a visit to Europe, and the publication of his works. When far away from the haunts of man, in the depths of forest solitude, happy days and nights of pleasant dreams attended him.

Only two years passed after his first interview with Lucien Bonaparte, in Philadelphia, before Audubon sailed for England. He arrived at Liverpool in 1826. Despondency and doubt seemed now to come upon him. There was not a known friend to whom he could apply in all the nation. And he imagined, in the simplicity of his heart, that every individual to whom he was about to present his subject might possess talents far superior to his own. For two days he traversed the streets of Liverpool, looking in vain for a single glance of sympathy.

There are kind and generous hearts everywhere, and men of noble faculties to discern the beautiful and true; and it was not long before Audubon's works procured him a generous reception from the most distinguished men of science and letters. In a short time he was the admired by all admirers.

Men of genius and honour, such as Cuvier, Humboldt, Wilson, Roscoe, and Swainson, soon recognized his lofty claim; learned societies extended to him the warm and willing hand of friendship; houses of the nobility were opened to him; and wherever he went, the solitary American woodsman, whose talents were so little appreciated but a few years before, that he was rejected after being proposed by Lucien Bonaparte as a member of the Lyceum of Natural History, in Philadelphia, was now receiving the homage of the most distinguished men of science in the old world.

Before the close of 1830, his first volume of the "Birds of America" was issued. It was received with enthusiastic applause; royal names headed the subscription list, and one hundred and

seventy-five volumes were sold at a thousand dollars each. In the mean time, (April, 1829), Audubon returned to America, to explore anew the woods of the middle and southern States.

The winter and spring of 1832 he passed in Florida and in Charleston. Early the ensuing summer he bent his steps northward, and explored the forests of Maine, New Brunswick, the shores of the Bay of Fundy and the Gulf of St. Lawrence, and the coast of Labrador. Returning as the cold season approached, he visited Newfoundland and Nova Scotia, and, rejoining his family, proceeded to Charleston, where he spent the winter in the preparation of his drawings and the accompanying descriptions. In the following spring, after nearly three years spent in travel and research, he sailed again for England.

In 1834, the second volume of his works was published. The three following years were passed in exploring Florida and Texas. A vessel was placed at his disposal by the government of the United States, to aid him in this noble enterprise. At the close of this period he published the fourth and last volume of plates, and the fifth volume of descriptions. The whole work comprises four hundred and thirty-five plates, containing more than one thousand figures, from the Bird of Washington to the tiny Humming-Bird, all represented of the size, colour, and attitude of life.

In 1839, having returned for the last time to his native country, and established himself with his family at his beautiful residence on the banks of the Hudson, near New York city, he commenced the republication in this country of the "Birds of America," in seven large octavo volumes, which were completed in 1844.

Before the expiration of this period, however, he began to prepare for the press the "Quadrupeds of America." In this work he was assisted by the Rev. John Bachman, D.D. Accompanied by his sons, Victor Gifford, and John Woodhouse, he explored the reedy swamps of the southern shores of America, traversed forest and prairie, making drawings and writing descriptions of quadrupeds. The first volume of "Quadrupeds" appeared in New York in 1846. This work, consisting, we believe, of five volumes, has

recently been concluded, and is no less interesting and valuable than the works of his earlier life.

Well might the great naturalist felicitate himself upon the completion of his gigantic task. He had spent nearly half a century "amid the tall grass of the far-extended prairies of the west, in the solemn forests of the north, on the heights of the midland mountains, by the shores of the boundless ocean, and on the bosom of the vast bays, lakes, and rivers, searching for things hidden, since the creation of this wondrous world, from all but the Indian who has roamed in the gorgeous but melancholy wilderness."

Speaking of the enjoyment of home after retiring from a vocation in which he had spent a long life, so earnestly, faithfully and triumphantly, he says, "Once more surrounded by all the members of my dear family, enjoying the countenance of numerous friends who have never deserted me, and possessing a competent share of all that can render life agreeable, I look up with gratitude to the Supreme Being, and feel that I am happy."

At the age of sixty, Audubon possessed the sprightliness and vigour of a young man. In person he was tall, and remarkably well formed. His aspect was sweet and animated; and the childlike simplicity of his manners, and the cheerfulness of his temper, were worthy of universal imitation. These made him beloved by all who knew him.

He used to say that he had no faith in genius; that a man could make himself what he pleased by labour, and, by using every moment of time, the mind might be kept improving to the end of life. "Look at facts, and trust for yourself; meditate and reason," he would say, "it is thus a man should educate himself."

It was his object to learn everything from the prime teacher—Nature. His extensive knowledge was the fruit of his own experiences. For some years past his health had been failing, and he was rarely seen beyond the limits of his beautiful residence. On the twenty-seventh of January, 1851, he died, full of years, and illustrious with the most desirable glory. He has indissolubly linked himself with the undying loveliness of nature, and thus left behind a monument of unending fame.



EASTERN RAMBLES AND  
REMINISCENCES.

## RAMBLE THE TWENTY-SEVENTH.

STOA OF ADRIAN, OR HADRIAN — THE  
MARKET-PLACE — GRECIAN DELICACIES  
— GATE OF THE AGORÆ — TOWER OF THE  
WINDS — THE WINDS SYMBOLICALLY  
EXPRESSED — THE CAVE OF AGRAULUS —  
THE PRYTANEUM AND CHORAGIC MONU-  
MENT OF LYSCRATES — GATE OF HA-  
DRIAN — THE OLYMPEION — THE KING  
AND QUEEN OF GREECE — FOUNTAIN OF  
CALLIRRHÖE — THE ILISSUS — THE STA-  
DIUM — MOUNT ANCHESMUS, AND THE  
VIEW FROM ITS SUMMIT.

Lorn echo of these mouldering walls,  
To thee no festal measure calls :  
No music through the desert halls  
Awakes thee to rejoice !  
How still thy sleep, as death profound,  
As if, within this lonely round,  
A step—a note—a whisper'd sound,  
Had ne'er aroused thy voice.

MRS. HEMANS.

Here let me sit upon this mossy stone,  
The marble column's yet unshaken base ;  
Here, son of Saturn ! was thy fav'rite throne ;  
Mightiest of many such ! Hence let me trace  
The latent grandeur of thy dwelling-place.  
It may not be ; nor e'en can Fancy's eye  
Restore what Time hath labour'd to deface :  
Yet these proud pillars claim no passing sigh ;  
Unmoved the Moslem sits, the light Greek  
carols by !

BYRON.

While swarm o'er swarm the gather'd nations  
hung ;  
And where round circles widening circles  
spread,  
And arch outsoaring arch  
Bathed in the sunbeams its ambitious head,  
Watch'd as the dying gladiator leant  
On his sustaining arm, and o'er the wound,  
Whence the large life-drops struggled, coolly  
bent,  
And calmly look'd on earth,  
As one who gradual sinks in still repose,  
His eye in death to close  
On the familiar spot that view'd his blissful  
birth.

\* \* \* \*

All ! all are swept away,  
Who made the world a gazing theatre,  
The arena, thund'ring to their war career !

SOTHEY.

I stood upon the hills, when Heaven's wide arch  
Was glorious with the sun's returning march,  
And woods were brighten'd, and soft gales  
Went forth to kiss the sun-clad vales.

LONGFELLOW.

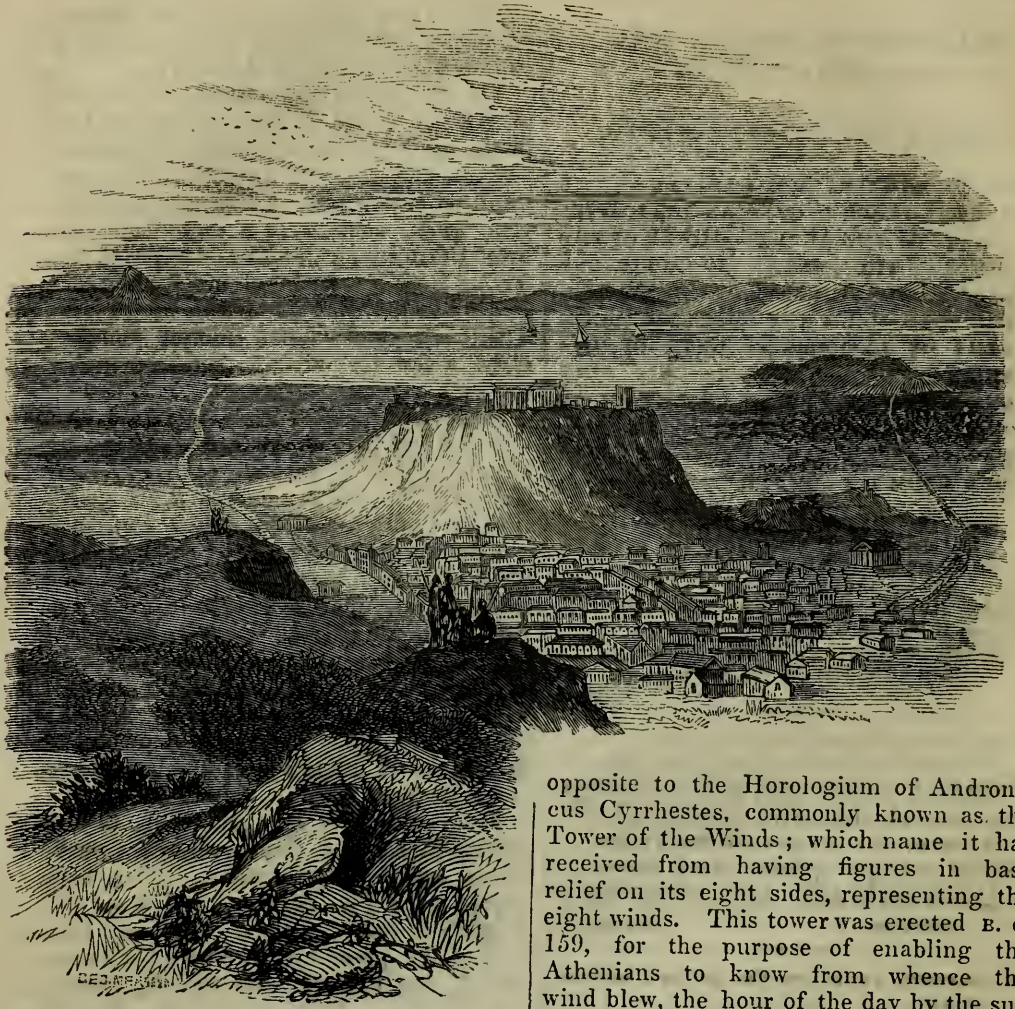
After a good night's rest at the *Hôtel de Munich*, we hired a guide and proceeded to explore the environs of Athens.

The first object of interest was the Stoa of Adrian, which is near to the market-place, partly hidden by modern buildings, palings, and heaps of rubbish. The portion that is now seen of this once magnificent work, consists of a high wall with seven Corinthian columns and capitols projecting from it ; each column formed of a single block of marble, and nearly perfect. There is a single fluted column standing alone, a few feet distant from the end of the wall.

Some antiquarians have imagined that this wall was part of the Temple of Jupiter Olympus, but it is now generally considered to be the remains of the magnificent Stoa built by Adrian, which contained a colonnade of Phrygian marble, and a library adorned with gilding, pictures, and exquisite statues, the works of Apelles, Praxiteles, and Phidias. Here the Athenians resorted to promenade, converse and read, and the wits of Athens held their meetings. In the centre of the inclosure are the ruins of a building which now form part of the church of Megáli Panaghía, answering to the library.

From the Stoa we proceeded to the market-place, and there saw the Greeks eating *echini* or sea-urelins, which they appear to enjoy quite as much as the English do native oysters. They are very fond of the pinna oyster, which they have stewed, and dressed with pepper, lemon, and vinegar. Another favourite dish is the *sepia* or cuttle-fish, which is boiled and the sepia itself poured over the fish as sauce, so that it comes to table looking literally as black as ink, and anything but inviting in its appearance to European tastes.

Passing out of the market we strolled to the gate of Agoræ, or new market, which consists of a portico of four fluted Doric columns, supporting a pediment ; and there is also a vestibule, formed between the columns by the remains of one of the antæ, which formed the termination of two walls, and the jambs of the door which opened into the Agoræ are now to be seen, antiquarians have deciphered the inscriptions upon the gate, which state that the building was erected out of the donations



VIEW OF ATHENS, FROM MOUNT ANCHESMUS,  
WITH THE TWO ROADS TO MUNYCHIA AND  
THE PEIRÆUS IN THE DISTANCE.

presented to Athens by Julius Cæsar and Augustus; and that a statue of Lucius Cæsar, the grandson of Augustus, was placed upon the summit of the gate, while the base was ornamented by a statue of Julia Augusta. A few feet from the gate, on the side of the road, is an oblong flat slab of stone, which is called the market tariff of Adrian, established for regulating the price of oil; the inscription upon it is clear, and tolerably perfect.

Passing over several heaps of rubbish, and pausing only to take a peep through the gates of the Greek prison, we arrived

opposite to the Horologium of Andronicus Cyrrhestes, commonly known as the Tower of the Winds; which name it has received from having figures in base relief on its eight sides, representing the eight winds. This tower was erected B. c. 159, for the purpose of enabling the Athenians to know from whence the wind blew, the hour of the day by the sun when the weather was fine, and by water when it was cloudy.

It has been doubted by some that this tower was a Clepsydra; but there cannot be a question about the matter, inasmuch as the hour was indicated in cloudy weather by means of water; and we know that the water-clock within the tower was supplied, in former days, by the stream which rises under the Cave of Apollo and Pan, at the north-west angle of the Acropolis. This is placed beyond conjecture, because part of the aqueduct used for conveying it from the fountain of Pan can now be seen built into the wall of a modern house.

The tower is built in the form of an octagon, so that each side faces the direc-



tion of one of the eight winds, which the Athenians employed in their division of the compass. In order that the people should not make any mistake about the proper wind that prevailed at the time, they inscribed the name on each side facing the direction whence it blew, and also had the ideal form of it sculptured underneath. Thus the unlearned could behold the symbol, and the learned the name of each wind.

On the north is the figure of *Boreas*, represented as an old man, with two wings, and his feet in buskins; he is blowing a twisted cone, and is in the act of covering himself with part of his thick and sleeved mantle, which appears to be much disturbed by the wind. On the whole, the father of snow, hail, rain and tempests looks remarkably severe, and considerably the worse for wear.

The next wind to *Boreas* is the north-east wind, called *Kaikias*, because it is supposed to blow from the River Kaukus in Asia. It is represented as an old man, with bare arms, grasping a plate of olives, which appears about to descend upon the people who may choose to enter the town, as this figure is placed immediately over the doorway. As this wind is favourable to olives, they have been employed in symbolising it.

The next wind proceeding eastward, is the east, or *Agelotes*, which is represented as a good-looking young man with a smiling countenance, and a lapful of fruit.

The south-east, or *Eurus*, appears to be a disagreeable man, with his right arm muffled in his mantle, hurrying onward with violence and impetuosity.

The south wind, or *Notos*, is represented as a young man, holding a jar under his right arm, from which he appears to be about to pour water upon the earth; part of the vessel is cut away, as though the sun-dial had originally been placed there.

The south-west wind is called *Lips*, because it was supposed to blow from Libya, and is represented as a young man with bare arms, holding the frame of a ship, which he appears to be propelling.

The next figure is that of *Zephyrus*, or the west wind, which is represented as a young man, with bare feet and chest, grasping a mantleful of flowers, and

floating as it were tranquilly in the air, scattering beauties from his mantle.

The last wind is the north-west, or *Skeiron*, represented as an old man, with a thick and sleeved mantle, holding a vessel, which he appears to have emptied upon the earth, indicating that he brings rain.

The winds are here represented as four young and four old men, all winged, and with similar mantles and buskins, with the exception of *Lips* and *Zephyrus* who are barefooted.

Below the figures are the solar-dials, accurately arranged in lines upon the face of the stone; and formerly the roof, which is formed of 24 stones, emblematical of the 24 hours, was surmounted by a bronze Triton. This figure turned on a pivot, and pointed out the direction from whence the wind blew, by means of a wand, which he held in the right hand.

From the Tower of the Winds we proceeded to the Cave of Agraulus, which is a rude excavation at the base of the rock of the Acropolis, about sixty yards from the Cave of Pan, and about the same height above the basement. The interior is dirty, and rugged, with thirteen niches, apparently for statues; and the general opinion of antiquarians is, that this spot was used as a sanctuary, or sacred enclosure, and communicated with the Acropolis by means of a passage, emerging near to the Temple of Pandrosus.

Not far from the Agrauium is the site of the Prytaneium, which was the commencement of the street of the Tripods, leading to the Theatre of Bacchus, and near at hand is the Choragic monument of Lysicrates, or, as it is sometimes called, the Lantern of Demosthenes, partly hidden from view by heaps of rubbish and the walls of a ruined house. It is an elegant little building, and serves to show us what the temples erected in the Street of Tripods were like; Lysicrates is said to have erected this monument to Bacchus after he had gained a victory in the theatre, and Praxiteles sculptured the ornamental part. The monument is circular, built entirely of white marble, with six fluted Corinthian columns, supporting an elegant frieze sculptured in bas relief, and surmounted by a cupola, but the figures are now destroyed by the wantonness of the Greeks or travellers.

Proceeding in a south easterly direction, we arrived at the Gate of Hadrian, which is near to the Temple of Jupiter Olympus, and is one of the existing monuments that has given considerable trouble to the antiquary, and caused much doubt in the mind of the traveller. It is not a very handsome monument, but perhaps in its palmy days, when there were not any weeds to wave their waving leaves over its crumbling walls, and broken pillars, and when the surrounding space was ornamented by graceful temples and monu-

ments, and peopled by thousands of spectators, the Arch of Hadrian might have formed an interesting feature in the landscape. Even now it breaks the monotony of the northern views as you turn your back upon the ruins of the Olympeion, and see little else but heaps of rubbish and barren tracks.

The arch bears two inscriptions,—the same that have puzzled the learned and provoked so much controversy,—the one on the north-west side of the arch runs thus

ΑΙΔΕΙΣΑΘΗΝΑΙΘΗΣΕΩΣΗΠΙΝΗΠΟΛΙΣ

(This is Athens, the ancient city of Theseus).

On the other side, facing the Olympeion, &c., is the following line—

ΑΙΔΕΙΣΑΔΡΙΑΝΟΥΚΑΙΟΥΧΙΘΗΣΕΩΣΠΟΛΙΣ

(This is the city of Adrian, not of Theseus).

The great matter of dispute is, whether the inscriptions should read “this is,” &c., or “what you see is,” &c. The difficulty has arisen from the words not being separated, and the whole dispute therefore rests with the first six letters. Without entering into the vexed question, I may remark, that the reading given unabridged above, appears to me to be the more correct reading, because while standing in the proper position to read the inscription, you cannot see the city named in it.

A short distance from the gate of Hadrian is the Olympeion, or the remains of the celebrated Temple of Jupiter Olympus, commenced by Pisistratus, about the year 530, B. C., but which was obliged to remain unfinished until Hadrian commenced and completed it, 650 years after Pisistratus had laid the foundation.

The temple consisted of 120 columns, six feet and a half in diameter, and upwards of sixty feet high, standing upon an artificial platform, supported by a wall on the south side. The whole length of the building was 354 feet, and its breadth 171.

At the present time we can see the peribolus on the south side, and only sixteen of the columns remaining, and there is also a queer-looking kind of a hut to be seen, high above the capitals of these elegant columns, where a fanatic once chose to live exposed to the winds and weather, living only by the charity of those who might place some food in the basket he lowered to them. It is currently reported

that he lived there for several years, and died in the hut, where his remains, most probably, can testify to the truth of the story even now.

I remember upon one occasion a great feast, when lambs are slaughtered wholesale, during my sojourn at Athens, that a party of us paid a visit to the ruins of the Temple of Jupiter Olympus, to see the games and amusements of the people. Groups of holiday-dressed Greeks, with their wives and daughters, were seated upon the grass and rocks along the banks of the Ilissus, then dried up, and the part known as “the Gardens,” was crowded with Athenian fashionables of both sexes. The men laced so tight at the waist, that there appeared an imminent danger of an expansion, and the women trying to astonish the natives with the cast off fashions of Paris and Bond-street of the previous two years. Here was a group dancing the Romaika, or national dance, which reminded me of an exhibition something between the dance of a drunken sailor, and a man who felt ashamed to be seen “tripping the light fantastic toe:” there were several Greeks gambling, swearing, and drinking; some making love, and discoursing vile sounds intended for music; and others gravely smoking, or plotting against the government. Presently all eyes were turned in one direction,—a buzz and a rushing of the people towards the ruins of the temple induced us to follow their example. We then saw King Otho



and his queen, attended by their retinue, driving round the ruins. The king is a very plain man, and, although a Bavarian, appears to have become a thorough Greek in his manners. The queen has, no doubt, been a pretty woman, but the expression of her face now is mournful, and even silly. The king is a Roman Catholic and the queen a Lutheran; they have not any children, a circumstance that causes much disagreement between them. About 150 yards from the Olympeion, is the celebrated fountain of Callirrhœe, mentioned by Thucydides, and sometimes called Enneacrunus, from the water being formerly distributed through wine-pipes. It is now nearly dry during the summer months, and is a very uninteresting spot, unless it be for its connection with ancient history, and being the place where Callirrhœe is said to have killed herself.

The Ilissus rises in Mount Hymettus, and receives some small streams in its course towards the Peiræus, but, unless in winter, I imagine that its bed is always dry, or nearly so; it was never otherwise during the period of my visit, unless for a few days at a time in the rainy season, and even then, it could scarcely be elevated to the dignity of a ditch. In former times it must have been a respectable little stream, if we may judge from the bed, which averages about 20 yards in breadth. Exactly in front of the Stadium are the piers of an ancient bridge, which had a span of about 70 feet, and consisted of three arches. This would almost lead us to believe that the Ilissus was formerly a stream of some importance.

The next place we inspected was perhaps without exception, the most interesting of all the places we had yet seen,—the Stadium of Athens, which is considered by many to have been the most magnificent in the world, and is unquestionably one of the most ancient of the remains about Athens.

Lycurgus levelled a torrent-bed upon the banks of the "cool Ilissus," marked out the form and plan, and had the first Stadium constructed about the year 350 B. C., or 180 years before Pisistratus laid the foundation of the Olympeion. Here the Panathenaic festivals were held, and about five centuries afterwards, Herodes, the son of Atticus rebuilt and adorned it

with all the refined taste of the time. The very seats were covered with the purest Pentelic marble, and so magnificent were the decorations and improvements made by Herodes, that nearly four years were occupied in completing the arrangements. Some idea may be formed of its size, when it is known that there were thirty rows of seats, capable of accommodating 25,000 spectators. The length of the stadium was nearly 800 feet, and its breadth from 140 to 180 feet. Upon one occasion nearly 40,000 spectators were assembled within the Stadium itself, and the sloping sides of the hills around, where the remains of the Temple of Fortune, and sepulchre of Herodes are now to be seen. Then Hadrian had a thousand wild beasts slaughtered in the arena to please the Athenians, who were assembled, most of them no doubt feeling

"That suspense  
Of being, that lay here on all around,  
When agony of pleasure charm'd each sense,  
In willing horror bound."

Then succeeded the triumph, the shouts of applause, the death groans of the beasts, and even of the gladiators themselves, pouring out their life's blood upon that vast arena, where Greece

"Inebriate, drank the blood of man.  
And swell'd the human hecatomb with gore  
Of birds and beasts, and monsters of the main;  
While death piled up the pyre,—the slayers on  
the slain."

From the Stadium we proceeded to Mount Anchesmus, and after a weary tramp up the rough road on its side, we arrived at the small church dedicated to St. George, which crowns its summit. Being situated on the north-east part of the city, the view from its peak is very fine, and interesting. The eye first rests upon the city below with its confused mass of houses and ruins, and the palace of King Otho. Then the rock upon which the Acropolis is built, rears itself above the surrounding country, forming the central and most imposing object in the landscape, for independent of its own commanding aspect, we behold the splendid remains of the Parthenon, with its stoned frieze, and elegant columns, standing in melancholy grandeur amid the other ruined temples, and away to its right is the Venetian tower. In the plain

below to the right of the Acropolis is the road to the Peiræus, and the Temple of Theseus. To the left is the Arch of Hadrian, the Temple of Jupiter Olympus, and the Stadium of Herodes, marking the most ancient portion of the city. To the left of the Acropolis the road to Munichia may be seen winding among the olive trees and gardens. Beyond all is the Ægean sea, studded with islands and light caïques, and lovely over all the scene

"Sleeps the sunny glow,  
When Morn and Eve, in tranquil splendour reign,  
And on thy sculptures, as they smile, bestow  
Hues that the pencil emulates in vain.  
Then the fair forms that Phidias wrought, unfold  
Each latent grace, developing in light;  
Catch from soft clouds of purple and of gold  
Each tint that passes, tremulously bright;  
And seem, indeed, whate'er devotion deems,  
While so suffused with heaven, so mingling with  
its beams."

### DIRECTIONS TO WRITE FOR PRINTERS.

YOU must not cover both sides of the paper, as in ordinary correspondence. It is very troublesome to the compositor, and will prove disadvantageous to yourself. For, if you write to a newspaper or other periodical, where payment is not required, this alone may cause the rejection of your communication, and, in case of publishing a work, it will considerably increase your expense.

Cut the paper into slips of any convenient size—say that of an octavo or quarto volume. Write on one side only, and number each at the bottom. You may, afterwards, connect them with a string, either at the top or sides, as may best suit your purpose.

If you think, notwithstanding all my explanations, that you cannot depend on your own punctuation, you will act wisely in not insisting on its being followed. Leave that to the compositor, and he will correct your errors, and preserve more consistency and uniformity throughout. But you must observe my directions, to commence each sentence with a capital letter, and finish with a period—otherwise your manuscript will be called "bad copy," and there will be an extra charge for loss of time, just the same as for a bad handwriting.

Unless you spell very accurately, leave the orthography, also, to the compositor.

Write all the terms of trade or science, proper names, foreign words, or those not in common use, particularly plain, by which you will escape some vexation, and extra charges for correction. Observe, in such cases, to make every *l* and *t* very plain, and that it shall not appear doubtful if an *n* be a *u*, or a *w* an *m*. Though you may hear to the contrary, give me leave to tell you, that our compositors are only obliged to know plain English. If, for civil, I write *civit*, for always, *atways*, for author, *anther*, for common *commou*—these they will spell right, but they are not supposed to know scarce or unusual, technical or foreign, words.

Draw one line underneath every word that you intend for italics—two lines for small, and three for large, capitals. But be very sparing of their use. Keep in mind that they are like superlatives, whose force will weaken in proportion to their frequency.

If you wish to make two or more paragraphs out of one that you think too long, place, at the end of the sentence where you wish the division, two crochets, back to back, thus. ] [ All printers know this mark so well, that they will make the new paragraph, without any other explanation or direction.

Avoid notes at the bottom of pages, though they are used by men of the greatest erudition. While they enhance the printing expenses, they are always irksome to the reader, because they unseasonably distract his attention. If explanations, not suited to the body of the work, occur, reserve them for the end, where you may put them altogether, and without extra charge. For observe, that nothing which is absolutely necessary, ought to be put in notes. They should be rather of a satisfactory than of an indispensable nature. Some writers carry this noting to a ridiculous extent, as, An author of eminence\* says—and then we look down and see \*NEWTON at the bottom like a fallen star. Since the name is given, no reader can conceive why it should not be inserted after *eminence*. I have often wished that printers would charge so high for such aberrations, that none but men of fortune could meddle with them. We should, then, but rarely see single names standing at the foot of a page, or that



intolerable nuisance, more notes than text.

I must again draw your attention to the necessity of writing plain. There would be no occasion to say a word on this point, if you knew as well as I do, the torments that gentlemen inflict on themselves by their wretched scrawls. They can have nothing to do with a printing-office without complaints of errors, which often make them ridiculous, and give them great vexation. But I know that, so far from this being the fault of the compositors, they take more pains than they ought, to decypher such hen-scratching writing. Though practice enables them to *guess* out bad manuscript with a more than ordinary readiness, they may be often seen handing about, from one to another, the illegible stuff of a peerless peer or an M.P., in the hope that, by chance, one might light upon the meaning of some word that defied interpretation by the context. Yet some of those dignified scribblers will affect a knowledge of punctuation too, and will bluster and prate about their senseless stops not being followed, although the compositor altered them only through ill-bestowed compassion for the *writer*, or lest ignorance might be imputed to himself. They will also, forsooth, introduce foreign scraps into their unintelligible English; but for this the compositor has a help in books wherein the usual quotations of empty-headed linguists are ready cut and dry in alphabetical order, and, if he can only make out the first word or two, he is almost certain of finding them in the list.

Of all foolborn notions of high-breeding, illegible writing is the most ludicrous. We may write a perfectly genteel and plain hand, without the formal cut of the clerk or school-master, but, whatever we may do in private concerns or correspondence, we should not make laughing-stocks or merry-andrews of ourselves, by going to the printing office with our *gentlemanly* scrawls.

Surround with a line everything that you do not intend to be printed. For want of this necessary precaution, strange observations sometimes appear that much annoy the writer. It is folly to talk of "the *stupidity* of the printer." Omissions are serious matters in his business, and he does it well if he leaves out nothing that

might, by possibility, be designed for insertion. You may be certain, however, that he will not meddle with any encircled words, except to read them for his direction.

Lastly, if you desire your name to appear, you may sign it in your customary manner, but write it a second time, very plain, to spare the compositor any trouble in giving you a new baptism. It is no part of his business to decypher hieroglyphics.

I shall now let you into a little of the technicalities of printing, as I am sure that such information will be acceptable. Compositors are those who arrange the types. Their work is called *composing* or *setting*, and whatever they set from, whether print or manuscript, is named *copy*. When finished, *pressmen*, not printers as they are commonly called, transmit the impression to paper, by a mechanical process not necessary to be described. A *printer* is, properly speaking, he who superintends or undertakes the entire management, and this is the reason that the word is often applied in a very extensive sense—every fault or excellency is said to be the printer's. As the best compositors are liable to make errors in setting, a printed *proof* of their work is furnished to the *reader*, commonly called "corrector of the press," who carefully compares it with the *copy*, which is slowly read aloud by a *reading-boy*, and notes any errors that occur. The corrected proof is sent back to the compositor, who rectifies the faults marked, but, where time permits, the reader generally requires a *revise*, or second proof, for his further security. The types, when arranged, are called *matter*, and when properly secured by an iron frame or *chase*, the whole is then a *form*. A *publisher*, who was formerly called "the bookseller," is the person who gives out or sells, any newly printed work, either to the trade or to the public. An editor of a newspaper or periodical work is at the head of the literary department, and, as he is supposed to know the feelings of the proprietor, he writes, rejects and alters what he pleases—the editor of a book is one who undertakes the revision of another's work, and makes either additions, abridgments, or changes that he always calls improvements.—*Brenan on Composition and Punctuation*. (An excellent work, published by Effingham Wilson.)

## PHYSIOLOGY.

PHYSIOLOGY is the Science of Life. By this term we mean a certain number of phenomena which manifest themselves in succession for a limited time in organized bodies.

Life is a first principle in nature. In the animal and vegetable kingdoms it presents considerable difference in degree. Its character in the vegetable creation is more uniform, and its phenomena more simple. We perceive in that kingdom, under the usual favouring circumstances, the vital operations of digestion, circulation, respiration, and assimilation go forward.

As soon, however, as the exciting causes are withdrawn, this principle subsides to a state of less activity, as in winter. The sound condition of such organs and textures as are necessary to the growth and propagation of the species, is merely preserved by its influence until a returning impulse excites its energies.

As we advance in the scale of creation, the operations of the vital principle become more distinct and numerous, and the mechanism provided for the performance of them more manifest and complex; and as they are performed in man, and the more perfect animals, constitute the discoveries of physiology.

In the human eye we perceive many proofs of the advance in the organization of one class of creation over another. It is reasonable to believe that some animals not possessing eyes are yet conscious of the presence of light, though unable to recognise a single object; while to others are given an optical instrument of such beauty and perfection as to excel all artificial imitations.

In some classes of animals the eye is fixed, by which a limited range of vision only can be had, and the animals require to turn the body or the head to enlarge it. In the higher animals, and in man, this necessity is to some extent removed by the faculty afforded to the eye of rolling about.

This motion is accomplished by one of the eight muscles which move the eye, called the *pulley* muscle, from its passing over and playing on a ligament, which acts as a pulley, and alters the direction

of the power of the muscle, enabling it to pull the eye downward and to one side, thus rolling the eyeball round.

The proneness of matter to change, which results in death, occasionally, even during life, appears to overbalance the vital power; some minute change in the nature of an organ occurs, it no longer performs its office as it should do, and it becomes *diseased*. Disease, then, is the overbalancing of the vital power by the more general law of progressive change.

To restore this organ to its primitive healthy structure and function is the *practice of medicine*; and when healthy, to keep it in its true tone and function by preventive measures, as by regulation of diet, exercise, climate, and general regimen, constitutes that important science called *Hygiene*, which is now demanding so much general attention in its application to public health, especially in large cities.

It is, however, a knowledge which every individual ought to possess, as his personal comfort and well-being depend much upon its possession. It cannot be understood without a fair knowledge of anatomy, or a description of the structure of the various parts of the body, and of physiology, or a description of the uses or functions which these several parts play.

Can anything be more wonderful to the uneducated than that which is known as sympathetic action of the human frame? When a person receives a blow upon the head his stomach becomes sick; when the sun glares upon his eye he may sneeze; when an agreeable dish is presented the mouth waters. All this is produced by this sympathetic action.

Yet to him who studies the nervous system in its minute distribution, connecting the most distant parts of the body together, the wonder of this action is lost in admiration. This intimate relation of all parts is seen. It will be seen that the nerves unite in the brain and the spine, and form a bond of connection between the external world, and the internal organs of the body.

As a machine can only be thoroughly known after it has been taken to pieces, down to its simplest elements, so with the human body—it requires to be studied to be known, to be known to be admired.



# POPULAR ASTRONOMY.

## LETTER XVI.

### PLANETS.—MERCURY AND VENUS.

"First, Mercury, amidst full tides of light,  
Rolls next the Sun, through his small circle bright;  
Our Earth would blaze beneath so fierce a ray,  
And all its marble mountains melt away.  
Fair Venus next fulfils her larger round,  
With softer beams, and milder glory crown'd;  
Friend to mankind, she glitters from afar,  
Now the bright evening, now the morning star."—*Baker.*

THERE is no study in which more is to be hoped for from a lucid arrangement, than in the study of astronomy. Some subjects involved in this study appear very difficult and perplexing to the learner, before he has fully learned the doctrine of the sphere, and gained a certain familiarity with astronomical doctrines, which would seem very easy to him after he had made such attainments. Such an order ought to be observed, as shall bring out the facts and doctrines of the science just in the place where the mind of the learner is prepared to receive them. Some writers on astronomy introduce their readers at once to the most perplexing part of the whole subject,—the planetary motions. I have thought a different course advisable, and have therefore commenced these Letters with an account of those bodies which are most familiarly known to us,—the earth, the sun, and the moon. In connection with the earth, we are able to acquire a good knowledge of the artificial divisions and points of reference that are established on the earth and in the heavens, constituting the doctrine of the sphere. You thus become familiar with many terms and definitions which are used in astronomy. These ought to be always very clearly borne in mind; and if you now meet with any term, the definition of which you have either partially or wholly forgotten, let me strongly recommend to you, to turn back and review it, until it becomes as familiar to you as household words. Indeed, you will find it much to your advantage to go back frequently, and reiterate the earlier parts of the subject, before you advance to subjects of a more intricate nature. If this process should appear to you a little tedious, still you will find yourself fully compensated by the clear light in which all the succeeding subjects will appear. This clear and distinct perception of the ground we have been over shows us just where we are on our journey, and helps us to find the remainder of the way with far greater ease than we could otherwise do. I do not, however, propose by any devices to relieve you from the trouble of thinking. Those who are not willing to incur this trouble, can never learn much of astronomy.

In introducing you to the planets (which next claim our attention), I will, in the first place, endeavour to convey to you some clear views of these bodies individually, and afterwards help you to form as correct a notion as possible of their motions and mutual relations.

The name *planet* is derived from a Greek word, (*πλανητης*, *planetes*), which signifies a *wanderer*, and is applied to this class of bodies, because they shift their positions in the heavens, whereas the fixed stars constantly maintain the same places with respect to each other. The planets known from a high antiquity are, Mercury, Venus, Earth, Mars, Jupiter, and Saturn. To these, in 1781, was added Uranus (or *Herschel*, as it is sometimes called, from the name of its discoverer); and, as late as the commencement of the present century, four more were added, namely, Ceres, Pallas, Juno, and Vesta; and since 1845, this addition to the solar system has been much more than doubled. These bodies are designated as follows:—1. Mercury, 2. Venus, 3. Earth, 4. Mars, 5. Vesta, 6. Juno, 7. Ceres, 8. Pallas, 9. Jupiter, 10. Saturn,

11. Uranus, 12. Astraea, 13. Hebe, 14. Iris, 15. Flora, 16. Metis, 17. Di Gasparis, 18. Neptune, and 19. yet unnamed.

The foregoing are called the *primary* planets. Several of these have one or more attendants, or satellites, which revolve around them as they revolve around the sun. The Earth has one satellite, namely, the moon; Jupiter has four; Saturn, seven; and Uranus, six. These bodies are also planets, but, in distinction from the others, they are called *secondary* planets.

You need never look for a planet either very far in the north or very far in the south, since they are always near the ecliptic. Mercury, which deviates furthest from that great circle, never is seen more than seven degrees from it: and you will hardly ever see one of the planets so far from it as this, but they all pursue nearly the same great route through the skies, in their revolutions around the sun. The new planets, however, make wider excursions from the plane of the ecliptic, amounting, in the case of Pallas, to thirty-four and a half degrees.

Mercury and Venus are called *inferior* planets, because they have their orbits nearer to the sun than that of the earth; while all the others, being more distant from the sun than the earth, are called *superior* planets. The planets present great diversities among themselves, in respect to distance from the sun, magnitude, time of revolution, and density. They differ, also, in regard to satellites, of which, as we have seen, three have respectively four, six, and seven, while more than half have none at all. It will aid the memory, and render our view of the planetary system more clear and comprehensive, if we classify, as far as possible, the various particulars comprehended under the foregoing heads. As you have had an opportunity, in preceding Letters, of learning something respecting the means which astronomers have of ascertaining the distances and magnitudes of these bodies, you will not doubt that they are really as great as they are represented; but when you attempt to conceive of spaces so vast, you will find the mind wholly inadequate to the task. It is indeed but a comparatively small space that we can fully comprehend at one grasp. Still, by continual and repeated efforts, we may, from time to time, somewhat enlarge the boundaries of our mental vision. Let us begin with some known and familiar space, as the distance between two places we are accustomed to traverse. Suppose this to be one hundred miles. Taking this as our measure, let us apply it to some greater distance, as that across the Atlantic Ocean,—say three thousand miles. From this step we may advance to some faint conception of the diameter of the earth; and taking that as a new measure, we may apply it to such greater spaces as the distance of the planets from the sun. I hope you will make trial of this method on the following comparative statements respecting the planets:

*Distances from the Sun, in miles*

1. Mercury . . .	37,000,000	6. Juno . . .	} 261,000,000
2. Venus . . .	68,000,000	7. Ceres . . .	
3. Earth . . .	95,000,000	8. Pallas . . .	
4. Mars . . .	142,000,000	9. Jupiter . . .	485,000,000
5. Vesta . . .	225,000,000	10. Saturn . . .	890,000,000
11. Uranus, or Herschel . . .		1,800,000,000	

The *dimensions* of the planetary system are seen from this Table to be vast, comprehending a circular space thirty-six hundred millions of miles in diameter. A railway car, travelling constantly at the rate of twenty miles an hour, would require more than twenty thousand years to cross the orbit of Uranus.

*Magnitudes.*

Diam. in miles.				Diam. in miles.			
1. Mercury . . .	.	.	3140	5. Ceres . . .	.	.	160
2. Venus . . .	.	.	7700	6. Jupiter . . .	.	.	89,000
3. Earth . . .	.	.	7912	7. Saturn . . .	.	.	79,000
4. Mars . . .	.	.	4200	8. Uranus . . .	.	.	35,000



We remark here a great diversity in regard to magnitude,—a diversity which does not appear to be subject to any definite law. While Venus, an inferior planet, is nine tenths as large as the earth, Mars, a superior planet, is only one seventh, while Jupiter is twelve hundred and eighty-one times as large. Although several of the planets, when nearest to us, appear brilliant and large, when compared with most of the fixed stars, yet the angle which they subtend is very small,—that of Venus, the greatest of all, never exceeding about one minute, which is less than one thirtieth the apparent diameter of the sun or moon. Jupiter, also, by his superior brightness, sometimes makes a striking figure among the stars; yet his greatest apparent diameter is less than one fortieth that of the sun.

### Periodic Times.

Mercury	revolves	around	the	sun	in	nearly	3	months.
Venus	"	"	"	"	"	"	$7\frac{1}{2}$	"
Earth	"	"	"	"	"	"	1	year.
Mars	"	"	"	"	"	"	2	years.
Ceres	"	"	"	"	"	"	$4\frac{2}{3}$	"
Jupiter	"	"	"	"	"	"	12	"
Saturn	"	"	"	"	"	"	29	"
Uranus	"	"	"	"	"	"	84	"

From this view, it appears that the planets nearest the sun move most rapidly. Thus, Mercury performs nearly three hundred and fifty revolutions while Uranus performs one. The apparent progress of the most distant planets around the sun is exceedingly slow. Uranus advances only a little more than four degrees in a whole year; so that we find this planet occupying the same sign, and of course remaining nearly in the same part of the heavens, for several years in succession.

After this comparative view of the planets in general, let us now look at them individually; and first, of the inferior planets, Mercury and Venus.

MERCURY and VENUS, having their orbits so far within that of the earth, appear to us as attendants upon the sun. Mercury never appears further from the sun than twenty-nine degrees, and seldom so far; and Venus, never more than about forty-seven degrees. Both planets, therefore, appear either in the west soon after sunset, or in the east a little before sunrise. In high latitudes, where the twilight is long, Mercury can seldom be seen with the naked eye, and then only when its angular distance from the sun is greatest. Copernicus, the great Prussian astronomer, (who first distinctly established the order of the solar system, as at present received,) lamented, on his death-bed, that he had never been able to obtain a sight of Mercury; and Delambre, a distinguished astronomer of France, saw it but twice. In our latitude, however, we may see this planet for several evenings and mornings, if we will watch the time (as usually given in the almanack) when it is at its greatest elongations from the sun. It will not, however, remain long for our gaze, but will soon run back to the sun. The reason of this will be readily understood from the annexed diagram, Fig. 48. Let S represent the sun, E the earth, and M, N, Mercury at its greatest elongations from the sun, and O Z P, a portion of the sky. Then, since we refer all distant bodies to the same concave sphere of the heavens, it is evident that we should see the sun at Z, and Mercury at O, when at its greatest eastern

Fig. 48.

elongation, and at P, when at its greatest western elongation; and while passing from M to N through Q, it would appear to describe the arc O P; and while passing from N to M through R, it would appear to run back across the sun on the same arc. It is further evident that it would be visible only when at or near one of its greatest elongations; being at all other times so near the sun as to be lost in his light.

A planet is said to be in *conjunction* with the sun when it is seen in the same part of the heavens with the sun. Mercury and Venus have each two conjunctions, the inferior and the superior conjunction. The *inferior conjunction* is its position when in conjunction on the same side of the sun with the earth, as at Q, in the figure: the *superior conjunction* is its position when on the side of the sun most distant from the earth, as at R.

The time which a planet occupies in making one entire circuit of the heavens, from

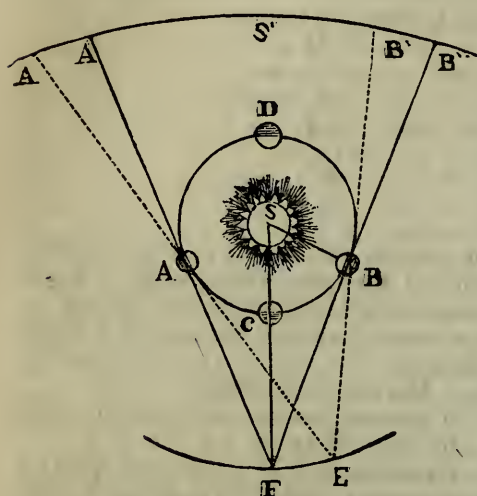


Fig. 49.

any star, until it comes round to the same star again, is called its *sidereal revolution*. The period occupied by a planet between two successive conjunctions with the earth is called its *synodical revolution*. Both the planet and the earth being in motion, the time of the synodical revolution of Mercury or Venus exceeds that of the sidereal; for when the planet comes round to the place where it before overtook the earth, it does not find the earth at that point, but far in advance of it. Thus, let Mercury come into inferior conjunction with the earth at C, Fig. 49. In about eighty-eight days, the planet will come round to the same point again; but, meanwhile, the earth has moved forward through the arc E E', and will continue to move while the planet is moving more rapidly to overtake her; the case being analogous to that of the hour and minute hand of a clock.

The synodical period of Mercury is one hundred and sixteen days, and that of Venus five hundred and eighty-four days. The former is increased twenty-eight days, and the latter, three hundred and sixty days, by the motion of the earth; so that Venus, after being in conjunction with the earth, goes more than twice round the sun before she comes into conjunction again. For, since the earth is likewise in motion, and moves more than half as fast as Venus, by the time the latter has gone round and returned to the place where the two bodies were together, the earth is more than halfway round, and continues moving, so that it will be a long time before Venus comes up with it.

The motion of an inferior planet is *direct* in passing through its superior conjunction and *retrograde* in passing through its inferior conjunction. You will recollect that the motion of a heavenly body is said to be direct when it is in the order of the signs from west to east, and retrograde when it is contrary to the order of the signs, or from east to west. Now Venus, while going from B through D to A, (Fig. 49,) moves from west to east, and would appear to traverse the celestial vault B' S' A' from right to left; but in passing from A through C to B, her course would be retrograde, returning on the same arc from left to right. If the earth were at rest, therefore, (and the sun, of course, at rest,) the inferior planets would appear to oscillate backwards and forwards across the sun. But it must be recollected that the earth is moving in the same direction with the planet, as respects the signs, but with a slower motion. This modifies the motions of the planet, accelerating it in the superior, and retarding it in the inferior, conjunction. Thus, in Fig. 49, Venus, while moving through B D A, would seem to move in the heavens from B' to A', were the earth at rest; but, mean-



while, the earth changes its position from  $E$  to  $E'$ , on which account the planet is not seen at  $A$ , but at  $A''$ , being accelerated by the arc  $A'A''$ , in consequence of the earth's motion. On the other hand, when the planet is passing through its inferior conjunction  $A C B$ , it appears to move backwards in the heavens from  $A'$  to  $B'$ , if the earth is at rest, but from  $A'$  to  $B''$ , if the earth has in the mean time moved from  $E'$  to  $E$ , being retarded by the arc  $B'B''$ . Although the motions of the earth have the effect to accelerate the planet in the superior conjunction, and to retard it in the inferior, yet, on account of the greater distance, the apparent motion of the planet is much slower in the superior than in the inferior conjunction, Venus being the whole breadth of her orbit, or one hundred and thirty-six millions of miles further from us when at her greatest, than when at her least, distance, as is evident from Fig. 49. When passing from the superior to the inferior conjunction, or from the inferior to the superior, through the greatest elongations, the inferior planets are *stationary*. Thus, (Fig. 49,) when the planet is at  $A$ , the earth being at  $E$ , as the planet's motion is directly towards the spectator, he would constantly project it at the same point in the heavens, namely,  $A'$ ; consequently, it would appear to stand still. Or, when at its greatest elongation on the other side, at  $B$ , as its motion would be directly from the spectator, it would be seen constantly at  $B'$ . If the earth were at rest, the stationary points would be at the greatest elongations, as at  $A$  and  $B$ ; but the earth itself is moving nearly at right angles to the planet's motion, which makes the planet appear to move in the opposite direction. Its direct motion will therefore continue longer on the one side, and its retrograde motion longer on the other side, than would be the case, were it not for the motion of the earth. Mercury, whose greatest angular distance from the sun is nearly twenty-nine degrees, is stationary at an elongation of from fifteen to twenty degrees; and Venus, at about twenty-nine degrees, although her greatest elongation is about forty-seven degrees.

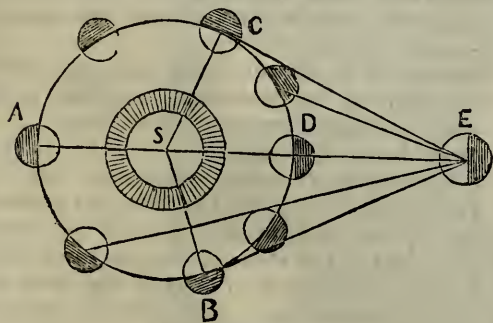


Fig. 50.

Mercury and Venus exhibit to the telescope *phases* similar to those of the moon. When on the side of their inferior conjunction, as from  $B$  to  $C$ , through  $D$ , (Fig. 50,) less than half their enlightened disc is turned towards us, and they appear horned, like the moon in her first and last quarters; and when on the side of the superior conjunction, as from  $C$  to  $B$  through  $A$ , more than half the enlightened disc is turned towards us, and they appear gibbous. At the moment of superior conjunction, the whole enlightened orb of the planet is

turned towards the earth, and the appearance would be that of the full moon; but the planet is too near the sun to be commonly visible.

We should at first thought expect, that each of these planets would be largest and brightest near their inferior conjunction, being then so much nearer to us than at other times; but we must recollect that, when in this situation, only a small part of the enlightened disc is turned towards us. Still, the period of greatest brilliancy cannot be when most of the illuminated side is turned towards us, for then, being at the superior conjunction, its light will be diminished, both by its great distance, and by its being so near the sun as to be partially lost in the twilight. Hence, when Venus is a little within her place of greatest elongation, about forty degrees from the sun, although less than half her disc is enlightened, yet, being comparatively near to us, and shining at a considerable altitude after the evening or before the morning twilight, she then appears in greatest splendour, and presents an object admired for its beauty in all ages. Thus Milton—

“ Fairest of stars, last in the train of night,  
If better thou belong not to the dawn,  
Sure pledge of day that crown'st the smiling morn  
With thy bright circlet.”

Mercury and Venus both *revolve on their axes* in nearly the same time with the earth. The diurnal period of Mercury is a little greater, and that of Venus a little less, than twenty-four hours. These revolutions have been determined by means of some spot or mark seen by the telescope, as the revolution of the sun on his axis is ascertained by means of his spots. Mercury owes most of its peculiarities to its proximity to the sun. Its light and heat, derived from the sun, are estimated to be nearly seven times as great as on the earth, and the apparent magnitude of the sun to a spectator on Mercury would be seven times greater than to us. Hence the sun would present to an inhabitant of that planet, with eyes like ours, an object of insufferable brightness; and all objects on the surface would be arrayed in a light more glorious than we can well imagine. (See Fig. 51.) The average heat on the greater portion of this planet would exceed that of boiling water, and therefore be incompatible with the existence both of an animal and a vegetable kingdom constituted like ours.

The motion of Mercury, in his revolution round the sun, is swifter than that of any other planet, being more than one hundred thousand miles every hour; whereas that of the earth is less than seventy thousand. Eighteen hundred miles every minute,—crossing the Atlantic Ocean in less than two minutes,—this is a velocity of which we can form but a very inadequate conception, although, as we shall see hereafter, it is far less than comets sometimes exhibit.

Venus is regarded as the most beautiful of the planets, and is well known as the *morning and evening star*. The most ancient nations, indeed, did not recognise the morning and evening star as one and the same body, but supposed they were different planets, and accordingly gave them different names, calling the morning star Lucifer, and the evening star Hesperus. At her period of greatest splendour, Venus casts a shadow, and is sometimes visible in broad daylight. Her light is then estimated as equal to that of twenty stars of the first magnitude. In the equatorial regions of the earth, where the twilight is short, and Venus, at her greatest elongation, appears very high above the horizon, her splendours are said to be far more conspicuous than in our latitude.

Every eight years, Venus forms her conjunction with the sun in the same part of the heavens. Whatever appearances, therefore, arise from her position with respect to the earth and the sun, they are repeated every eight years, in nearly the same form.

Thus, every eight years, Venus is remarkably conspicuous, so as to be visible, in the daytime, being then most favourably situated, on several accounts; namely, being nearest the earth, and at the point in her orbit where she gives her greatest brilliancy, that is, a little within the place of greatest elongation. This is the period for obtaining fine telescopic views of Venus, when she is seen with spots on her disc. Thus two figures of the annexed diagram (Fig. 52) represent Venus as seen near her inferior conjunction, and at the period of maximum brilliancy. The former situation is favourable for viewing her inequalities of surface, as indicated by the roughness of the line which separates the enlightened from the unenlightened part, (the *terminator*.) According to Schroeter, a German astronomer, Venus has mountains twenty-two miles high. Her mountains, however, are much more difficult to be seen than those of the moon.

The sun would appear, as seen from Venus, twice as large as on the earth, and its light and heat would be augmented in the same proportion. (See Fig. 51.) In many respects, however, the phenomena of this planet are similar to those of our own; and the general likeness between Venus and the earth, in regard to dimensions, revolutions, and seasons, is greater than exists between any other two bodies of the system.

I will only add to the present Letter a few words on the *transits* of the inferior planets.

The transit of Mercury or Venus is its passage across the sun's disc, as the moon passes over it in a solar eclipse. The planet is seen projected, on the sun's disc in a small, black, round spot, moving slowly over the face of the sun. As the transit takes place only when the planet is in inferior conjunction, at which time her motion is retrograde, it is always from left to right; and, on account of its motion being



retarded by the motion of the earth, (and was explained by Fig. 49, page 44,) it remains sometimes a long time on the solar disc. Mercury, when it makes its transit across the sun's centre, may remain on the sun from five to seven hours.

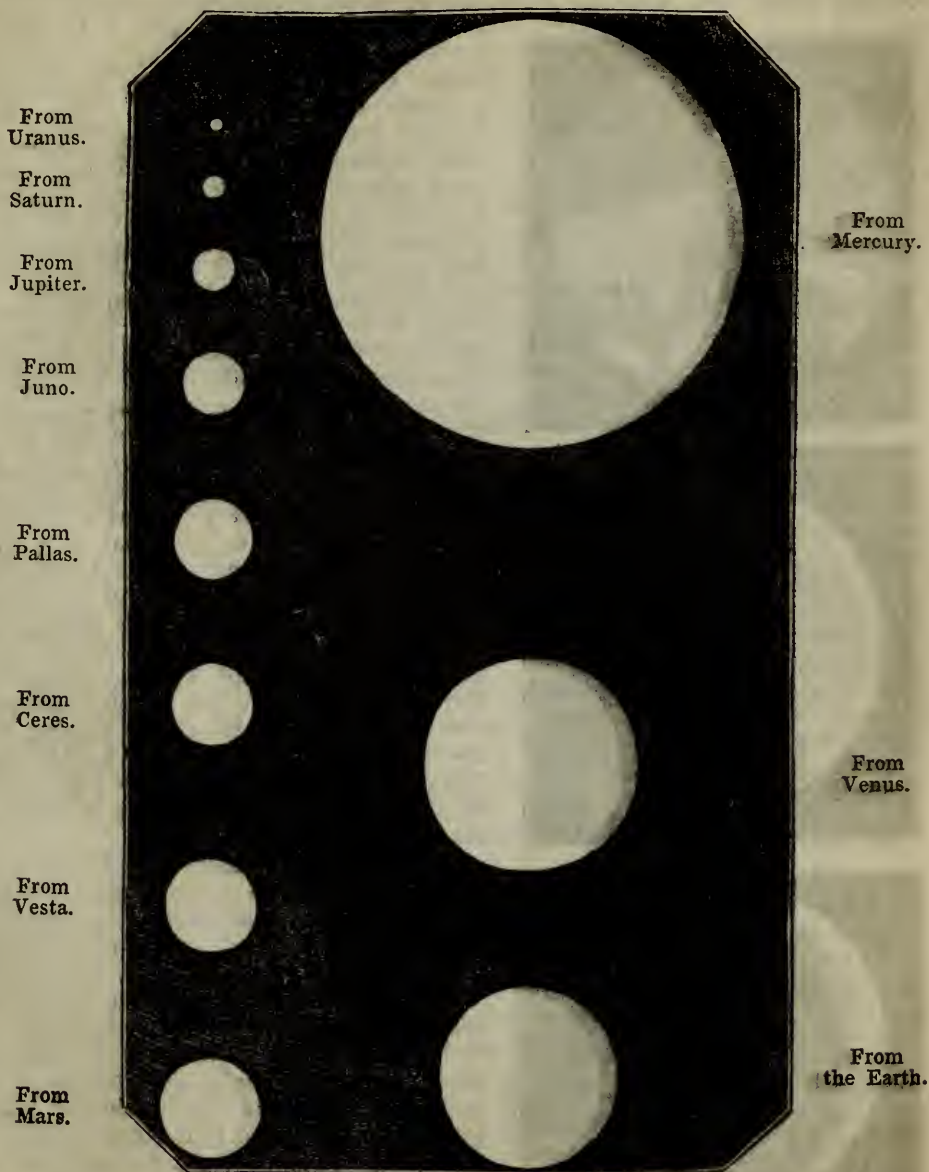


Fig. 51.—APPARENT MAGNITUDES OF THE SUN, AS SEEN FROM THE DIFFERENT PLANETS.

You may ask, why we do not observe this appearance every time one of the inferior planets comes into inferior conjunction, for then, of course, it passes between us and the sun. It must, indeed, at this time, cross the meridian at the same time with the sun; but because its orbit is inclined to that of the sun, it may cross it (and generally does) a little above or a little below the sun. It is only when the conjunction takes

place at or very near the point where the two orbits cross one another, that is, near the *node*, that a transit can occur. Thus, if the orbit of Mercury, N M R, Fig. 48, (page 243,) were in the same plane with the earth's orbit (and of course with the sun's apparent orbit), then, when the planet was at Q, in its inferior conjunction, the earth

being at E, it would always be projected on the sun's disc at Z, on the concave sphere of the heavens, and a transit would happen at every inferior conjunction. But now let us take hold of the point R, and lift the circle which represents the orbit of Mercury upwards seven degrees, letting it turn upon the diameter *ab*; then, we may easily see that a spectator at E would project the planet higher in the heavens than the sun; and such would always be the case, except when the conjunction takes place at the node. Then the point of intersection of the two orbits being in one and the same plane, both bodies would be referred to the same point on the celestial sphere. As the sun, in his apparent revolution around the earth every year, passes through every point in the ecliptic, of course he must every year be at each of the points where the orbit of Mercury or Venus crosses the ecliptic, that is, at each of the nodes of one of these planets;\* and as these nodes are on opposite sides of the ecliptic, consequently, the sun will pass through them at opposite seasons of the year, as in January and July, February and August. Now, should Mercury or Venus happen to come between us and the sun, just as the sun is passing one of the planet's nodes, a transit would happen. Hence the transits of Mercury take place in May and November, and those of Venus, in June and December.

Transits of Mercury occur more frequently than those of Venus. The periodic times of Mercury and the earth are so adjusted to each other, that Mercury performs nearly twenty-nine revolutions while the earth performs seven. If, therefore, the two bodies meet at the node in any given year, seven years afterwards they will meet nearly at the same node, and a transit may take place, accordingly, at intervals of seven years. But fifty-four revolutions of Mercury correspond still nearer to thirteen revolutions of the earth; and therefore a transit is still more probable after intervals of thirteen years. At intervals of thirty-three years, transits of Mercury are exceedingly probable, because in that time Mercury makes almost exactly one hundred and thirty-seven revolutions. Intermediate transits, however, may occur at the other node.



Figs. 52, 53, 54.

VENUS AND MARS.

\* You will recollect that the sun is said to be at the node, when the places of the node and the sun are both projected, by a spectator on the earth, upon the same part of the heavens.



Thus, transits of Mercury happened at the ascending node in 1815, and 1822, at intervals of seven years; and at the descending node in 1832, which will return in 1845, after thirteen years.

Transits of Venus are events of very unfrequent occurrence. Eight revolutions of the earth are completed in nearly the same time as thirteen revolutions of Venus; and hence two transits of Venus may occur after an interval of eight years, as was the case at the last return of the phenomenon, one transit having occurred in 1761, and another in 1769. But if a transit does not happen after eight years, it will not happen at the same node, until an interval of two hundred and thirty-five years; but intermediate transits may occur at the other node. The next transit of Venus will take place in 1874, being two hundred and thirty-five years after the first that was ever observed, which occurred in 1639. This was seen, for the first time by mortal eyes, by two youthful English astronomers, Horrox and Crabtree. Horrox was a young man of extraordinary promise, and indicated early talents for practical astronomy, which augured the highest eminence; but he died in the twenty-third year of his age. He was only twenty when the transit appeared, and he had made the calculations and observations, by which he was enabled to anticipate its arrival several years before. At the approach of the desired time for observing the transit, he received the sun's image through a telescope in a dark room upon a white piece of paper, and after waiting many hours with great impatience (as his calculation did not lead him to a knowledge of the precise time of the occurrence), at last, on the 24th of November, 1639, old style, at three and a quarter hours past twelve, just as he returned from church, he had the pleasure to find a large round spot near the limb of the sun's image. It moved slowly across the sun's disc, but had not entirely left it when the sun set.

The great interest attached by astronomers to a transit of Venus arises from its furnishing the most accurate means in our power of determining the *sun's horizontal parallax*,—an element of great importance, since it leads us to a knowledge of the distance of the earth from the sun, which again affords the means of estimating the distances of all the other planets, and, possibly, of the fixed stars. Hence, in 1769, great efforts were made throughout the civilized world, under the patronage of different governments, to observe this phenomenon under circumstances the most favourable for determining the parallax of the sun.

The common methods of finding the parallax of a heavenly body cannot be relied on to a greater degree of accuracy than four seconds. In the case of the moon, whose greatest parallax amounts to about one degree, this deviation from absolute accuracy is not very material; but it amounts to nearly half the entire parallax of the sun.

If the sun and Venus were equally distant from us, they would be equally affected by parallax, as viewed by spectators in different parts of the earth, and hence their *relative* situation would not be altered by it; but since Venus, at the inferior conjunction, is only about one third as far off as the sun, her parallax is proportionally greater, and therefore spectators at distant points will see Venus projected on different parts of the solar disc, as the planet traverses the disc. Astronomers avail themselves of this circumstance to ascertain the sun's horizontal parallax, which they are enabled to do by comparing it with that of Venus, in a manner which, without a knowledge of trigonometry, you will not fully understand. In order to make the difference in the apparent places of Venus on the sun's disc as great as possible, very distant places are selected for observation. Thus, in the transits of 1761 and 1769, several of the European governments fitted out expensive expeditions to parts of the earth remote from each other. For this purpose, the celebrated Captain Cook, in 1769, went to the South Pacific Ocean, and observed the transit at the island of Otaheite, while others went to Lapland, for the same purpose, and others still, to many other parts of the globe. Thus, suppose two observers took their stations on opposite sides of the earth, as at A, and B, (Fig. 55, page 250); at A, the planet V would be seen on the sun's disk at *a*, while at B, it would be seen at *b*.

The appearance of Venus on the sun's disk being that of a well-defined black spot, and the exactness with which the moment of external or internal contact may be

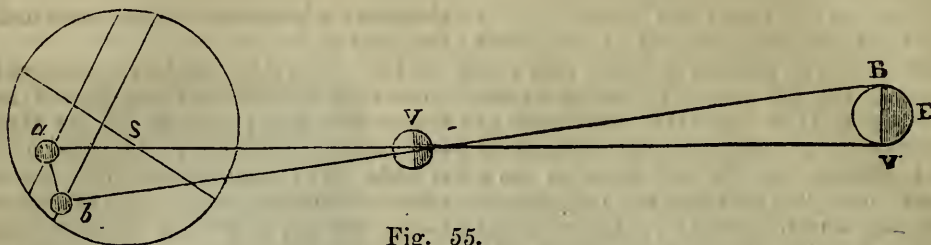


Fig. 55.

determined, are circumstances favourable to the exactness of the result; and astronomers repose so much confidence in the estimation of the sun's horizontal parallax, as derived from observations on the transit of 1769, that this important element is thought to be ascertained within one tenth of a second. The general result of all these observations gives the sun's horizontal parallax eight seconds and six tenths,—a result which shows at once that the sun must be a great way off, since the semidiameter of the earth, a line nearly four thousand miles in length, would appear at the sun under an angle less than one four hundredth of a degree. During the transits of Venus over the sun's disc, in 1761 and 1769, a sort of penumbral light was observed around the planet, by several astronomers, which was thought to indicate an *atmosphere*. This appearance was particularly observable while the planet was coming on or going off the solar disc. The total immersion and emersion were not instantaneous; but as two drops of water, when about to separate, form a ligament between them, so there was a dark shade stretched out between Venus and the sun; and when the ligament broke, the planet seemed to have got about an eighth part of her diameter from the limb of the sun. The various accounts of the two transits abound with remarks like these, which indicate the existence of an atmosphere about Venus of nearly the density and extent of the earth's atmosphere. Similar proofs of the existence of an atmosphere around this planet are derived from appearances of twilight.

The elder astronomers imagined that they had discovered a *satellite* accompanying Venus in her transit. If Venus had in reality any satellite, the fact would be obvious at her transits, as, in some of them at least, it is probable that the satellite would be projected near the primary on the sun's disc; but later astronomers have searched in vain for any appearances of the kind, and the inference is, that former astronomers were deceived by some optical illusion.

(To be continued.)

**A MOTHER'S LOVE.**—A writer beautifully remarks, that a man's mother is the representative of his Maker. Misfortune, and even crime, set up no barrier between her and her son. Whilst his mother lives he will have one friend on earth who will not listen when he is slandered, who will not desert him when he suffers, who will solace him when in sorrow, and speak to him of hope when he is ready to despair. Her affection knows no ebbing tide; it flows on from a pure fountain, spreading happiness through all this vale of tears, and ceases only at the ocean of eternity.

**POPULAR PROVERBS.**—Pride frustrates its own desire; it will not mount the steps of the throne, because it has not yet the crown on.—Sound not the vain trumpet of self-condemnation, but forget not to remember your own imperfections.—The thinking man hath wings; the acting man has only feet and hands.—The purest joy that we can experience in one we love, is to see that person a source of happiness to others.—Kindly appreciative words may bring upon the spirit of a man a softening dew of humility, instead of feeding within him the boisterous flame of vanity.



## THE MIRROR OF NATURE.

*(Continued from page 224.)*

IT may be said that hardly any other department of natural science offers to the natural desire of penetrating to the foundation of things such nutriment as chemistry. A youthful curiosity, fresh and earnest, like that of Duval's, must pause over the phenomena presented in the undiscovered world of the earths and alkalis with the same excited interest with which the old alchemists mixed their compositions in their glass retorts, and watched the substances which they subjected to the fire, the play of their colours, and their motions. What pleasure to follow the threads of analogy which lead from this domain of Nature into others. We lay a ball of silver white shining potassium upon the surface of a mass of mercury, to which we have previously imparted a slight moisture by breathing on it, and immediately the ball begins a rotatory motion, and describes a path on the quicksilver, the surface of which is immediately purified of the moisture, and becomes covered with another fine casing, which consists of a combination of the potash and water, drawn in the first place from the mercury and then from the air. The ball of potassium, which, in its motion, has become an oxyde (potash), and its watery combination (a hydrate), describes, as the casing sticks to it, a circle growing less and less, and at the moment at which the ball entirely disappears, the quicksilver is covered wholly with a thin layer of potassa. When a metal ball of the same kind is laid upon water, it instantly begins to move quickly, developing great heat with a reddish flame, on the extinction of which a little clear pearly ball remains, which, however, appears but for an instant, and then explodes with a cracking noise. The potassium has thus, by being burnt with the oxygen gas of the water, been changed into an oxyde (potassa), and the heat at the same time reaches so high a degree that even the hydrogen (of which hereafter) that escapes is inflamed. By similar phenomena is the oxydation of several of the metals accompanied, and we meet here for the first time the agency of those natural powers, which, although varying accord-

ing to their causes, nevertheless, produce by one and the same law the motions of the celestial bodies round their axes and in their orbits.

There is another metallic body which appears to us still more enigmatical than the nature and properties of the alkalis and alkaline earths, viz: the base of the volatile alkali, ammonia, on this account called *ammonium*. So far as experiment has hitherto gone, we hold that the metals are simple substances or elements incapable of further decomposition. Here, in ammonium, we find a metal capable of a polarisation, a decomposition into two opposite substances, nitrogen and hydrogen. What new views and changes may await us in regard to the elements and the peculiar condition of their existence and of their persistence, science at its present stage can form no conjecture.

The metallic bases of the alkalis and earths differ also from the metals proper in that they cannot remain pure or even mixed with another, if water or air comes in contact with them, but they must in this case immediately combine with the oxygen gas and become oxydised. Herein they are akin to water,—that important element, which everywhere enters, as mediator and participator into the processes of organic life, as well as into the polaric agencies of the unorganised material world. For that basis of water also, which corresponds to the metal of the oxyde, hydrogen gas, cannot be kept in its purity in the exterior world, but speedily becomes water again in composition with oxygen gas.

Water, on the one hand, and the mountainous ranges with which the whole habitable land is connected on the other, constitute the surface of our earth. But that which gives to the solid earth its chief solidity, and to the sea its peculiar consistency, are the oxydes of the metallic earths and alkaline metals, or in other words, the earths and alkalis themselves. Alumina (the basis of clay) is a chief ingredient of the primitive high mountain ridges; an immense portion of the mountain ranges, of the hills as well as of the plains, consists of lime; the mineral alkali or soda, as a main ingredient of common salt, fills the ocean as well as the salt lakes and salt beds of certain coun-

tries. Even in the kingdom of organised nature, in vegetable and animal bodies, lime and the alkalis are found; the former forms itself into bones, while of the alkalis, soda, in the form of common salt, is mingled with the secretions of the body; instead of soda or the mineral alkali appears in most plants the vegetable alkali (potash).

As an extraordinary strong attraction, for oxygen shows itself in the metals of this order, the same attraction is found in the oxydes, arising from their combination with oxygen. And in fact in an increased degree, inasmuch as it no longer finds a sufficient supply in the finer, ærial oxygen gas; but turns to the denser acids. The oxyde of calcium is the caustic, or so called *unslacked lime*, the oxydes of kalium and natrium are the caustic alkalis. The burnt or unslacked lime attracts not only the water with such violence that great heat is generated thereby, but also the carbonic acid, or, with yet greater eagerness, the sulphuric, phosphoric and fluoric acids; very frequently it is found united also with silicic acid (ch. 21). The oxyde of natrium, the caustic mineral alkali, as it occurs in the material world, has found opportunity to combine with a substance of interesting properties of which we shall speak in the next chapter, *chlorine*, or what was earlier called *muratic acid*. Without the result of this combination, without common salt, it would go ill with the economy of individuals and of whole nations.

The oxydes of the alkalis and of the four alkaline earths, lime, barytes, strontia and magnesia, have before their combination with water and the different acids, a destructive (caustic) effect upon organised bodies, which, especially in the case of the oxyde of barytes, is so powerful that, both in relation to men and animals, it may be ranked among deadly poisons. The oxydes of the other above-named earths exist, without any further combination with acids and water, as self-subsistent bodies, and show no caustic quality.

Even still, in their concealed and disguised condition, the metals of the alkalis and the alkaline earths act with great force in the relations of the earth and its living beings. Yet more powerful must their agency have been, when they first

appeared pure in their decided metallic polarity. What an intense heat must have been generated in the combination of the immense quantities of calcium with oxygen! what motions must have been produced by this process in certain parts as well as in the collective mass of the surface of the planet! There may yet be now in the depths of the solid earth, here and there, single masses of metallic earths, which, by the fixed and firm nature of the matter around them, have been locked up against the water and the air, and which now, when in any way water is let into them, produce quakings of the earth; and, where it is possible, many of those fiery outbreaks form the upper rind of the planet, which we call volcanoes.

*A few observations on Cleanliness.*—In my travels, and during my short residence in Egypt, I often looked with great pity upon the little children of the *Fellahs* or peasants of that country, who live in a condition of great want and wretchedness. These poor little creatures sit quite naked, or wrapt in a few rags before their clay hovels, and their faces as well as their bodies are so covered with dirt that it is impossible to distinguish the colour of their complexions. The dust and dirt adhere so thickly to the lids and corners of their eyes, that they appear to be in danger of losing their sight. Their eyes look so red and inflamed, and must be so painful, that the lesser annoyance caused by the multitudes of flies seems not to be regarded; for they seldom make any attempt to drive the insects away. They stare eagerly, half-blinded as they are, at the stranger, with the hope that he may toss them a bit of bread. A benevolent European lady took in charge several of these unfortunate children, had them washed and clothed, taking special care to cleanse their eyes; and when they were fairly freed from their misery and filth, they became so pretty and lively that, in a few weeks, they could hardly be recognised.

As to water, to cleanse their children and the rags in which they are clad, those Egyptian Fellahs stand in no manner of need. They have the Nile and its canals, or, a part of the year through, quantities of water left in the vicinity of the river after its overflow, in the hollows of the



land. But the heavy burthens which oppress the people, the labour to which they are forced, harder even than that under which the Israelites formerly groaned on the same spot, makes them insensible to everything but their animal wants and bodily fatigue; they think only of satisfying their hunger, and take no further care of their bodies.

Even the Bedouins, who guided us through the desert to Sinai, and then to Acaba, as well as those who conducted us through the deserts of Arabia, rubbed themselves off, during the journey, chiefly with sand, instead of washing with water; but they had good reason therefore; the water which their camels carried in leathern bottles was hardly sufficient to satisfy their thirst. And when these people, upon whom no hard yoke pressed as upon the Egyptian Fellahs, but who moved and breathed freely in their deserts, found opportunity to cleanse themselves with water, they gladly availed themselves of it. When one met people of this description, it could be ascertained by their cleanliness, whether they belonged to a free and prosperous tribe, or to a less favoured race.

A sagacious and justly celebrated man of science, J. Liebig, in his "Chemical Letters," expresses the opinion, that the greater or less use of soap affords a standard whereby to ascertain the condition and culture of States; for the use of this means of purification "depends not on fashion, not on a whim of the palate, but on a feeling of the beautiful, of well-being, and of the comfort springing from cleanliness." A country, in which, with the same number of inhabitants, a greater quantity of soap is used, confirms us in the conclusion, that the condition of its population is externally more prosperous and civilised than that of another where less soap is used. And not only as to external culture, but also, in reference to the well-being of the inner man, external cleanliness enables us to draw conclusions. A divine of the last century once affirmed, that an uncleanly man is no Christian; and that a good Christian cannot endure any dirt upon his outer man. And in fact that the human body is destined to become and to be a temple of God is urged upon us not as an external, arbitrary law

—it is written deeply, in the living necessities of our being. There are poor huts in which the greatest cleanliness reigns, because there dwells also in the hearts of their inmates a spirit of purity and order; and there are well-built houses, whose interior condition testifies to the reverse.

To the cleansing of our clothes, our chamber-floors, and especially of our bodies, soap affords the most effectual means. It consists in the combination of a caustic alkali with an oily or fatty substance; but the caustic dissolving property is so active that it is capable of readily removing any superficial impurity. Not only to us, but to the nations of the remotest antiquity, the use of soap, as supplying an actual necessity, was known. We find it mentioned in the Old Testament (Jer. ii. 22; Mal. iii. 2). In the time of the Roman naturalist, Pliny, it was understood that the ancient Gauls among all the nations of the west were the first acquainted with the preparation and use of soap (Pliny, H. N. xxviii. 12, 2). And even the German people appear to have been famous, according to the same author, for furnishing the nations of Italy with soap. The descendants, or at least so far as their places of abode are concerned, the successors of both the above-named nations, the French, and among the German branches, the cleanly Netherlanders and the inhabitants of the countries bordering on the North Sea, are still distinguished in the same way. In the universal use of soap they are in advance of all the nations of Europe.

Not only to the higher ranks, but also to the middle classes, among all civilised nations, the use of soap has become indispensable. When formerly the heavy taxes imposed on soap-boilers rendered it difficult for the poorer sort of people to obtain ordinary soap, the country-people in England invented a substitute from the ashes of the fern, the potash of which they mixed with animal fat, and so produced a good article for cleansing.

Our soap-boilers still use the vegetable alkali (potash) for the preparation of soap as it was formerly used by the English peasants. It is obtained by washing out the lye of various plants and then the lye evaporates, until at last a blueish or gray-

ish white sediment remains, which is known under the name of potashes. Out of very many different kinds of plants, trees, and shrubs, from the ashes of our fuel-wood, and also from our vine-wood and straw, this article may be prepared, and in those countries in which there exist extensive forests, where superabundant wood must decay unused, great quantities of wood are burnt merely to obtain potashes. In such a way an immense quantity of potashes was formerly and is still produced in North America. From New York alone tens of thousands of barrels have been exported to Europe yearly. The wooded districts of the Russian Empire and of Norway, likewise produce great quantities of potashes, and even in Germany and elsewhere, this article is prepared in no inconsiderable measure from the ashes of the household hearth and from the large fire-places of manufactories. But potashes are not a pure vegetable alkali; they contain of this at the highest only sixty to sixty-three per cent., indeed less than half of their weight; for, besides the water and carbonic acid which are combined in them, they contain earthy parts, especially silica and sulphuric acid. Besides, the soap which is prepared directly from the lye of wood ashes (vegetable alkali) is much inferior in solidity and usefulness to that which is obtained from a mineral alkali (soda); on which account, to the mixture of wood ashes, lye and fat, when they are being boiled down to make soap, in order to give it more consistency, common salt is added, the mineral alkali or soda of which unites in part with the fat, while its muriatic acid combines with the vegetable alkali of the lye.

This trouble might be spared, and a much better soap obtained into the bargain, if a solution of soda, instead of the lye of wood-ashes, were used. This strongly caustic alkali exists, as we have said, in immense quantities; for, with the muriatic acid there is formed common salt and the sea-salt, which makes the ocean saline. An ounce and more of cooking salt may be obtained by evaporation from a pound of water from the ocean, if no large rivers empty themselves into the ocean in the neighbourhood; and where the climate permits, the heat of the sun

is sufficient to produce the requisite evaporation in the shallow inlets or artificial hollows into which the sea water flows. And not only the sea, even the land, in some mountainous regions, contains immense masses of common salt, which is obtained just as pure, partly by washing out the clay, and sea-slime combined with it.

But all this abundance of soda in common salt is in itself useful neither to the soap-boilers nor the glass-makers, if it is united with chlorine, and must first be separated with much labour from this combination. *Soda*, or the impure mineral alkali, is more readily obtained in easier ways. The same substance, in some countries, especially in Egypt, in the natron lakes of that land, and in Hungary between Debresin and Grosswardein and in other salt lakes, is found as carbonate of soda, which is tolerably easily cleansed of the sulphate of soda and common salt mixed with it; and is freed by heat from its carbonic acid as well as the carbonate of lime and potash. But even a portion of the vegetable kingdom produces from its ashes the mineral alkali or soda; of this character are some families of the plants that grow on the sea-coast or in soils in the interior, abounding in salt, especially the different species of salt sprig, and salt corn or grain plants, and many sea-weeds and sea-grasses. On the Spanish coast such a quantity of soda is obtained by burning these plants (*Barilla*), and extracting their lye, that many shiploads are exported yearly to Holland. Soda is obtained in equal abundance in Sicily, and especially in the little island of Ustica. In Astrachan, and even on the coasts of Norway, sea-weed is used for the same purpose.

The mind of man, with its inventive faculties, was not, however, to be satisfied with half ways. What Nature accomplishes in the living bodies of plants, namely, the separation of soda in sea salt from its union with chlorine, man's art was destined to achieve also. As necessity formerly led the country-people in England to discover a substance in the roots of the fern, which serves for the preparation of soap, so likewise the trading people in France found out a method of obtaining soda, which indeed was not unknown;



but had previously been neglected. France, the country of the greatest soap manufacture, had yearly taken, especially from Spain, twenty to thirty millions of francs' worth of soda, although the price per cwt. did not amount to more than twenty-four or thirty francs. But when, during the war which Napoleon waged with England, the importation of this article was cut off, many soap and glass-makers had to suspend their business, and the price of soap and glass rose immensely. But although the free commerce of the ocean was interrupted, the ocean itself remained to an inventive people. It had long been known that soda can be obtained from common salt by expelling the chlorine of the same by a strong acid. When one hundred pounds of common salt are mixed with about eighty pounds of concentrated sulphuric acid, the chlorine escapes in the form of vapour, and sulphate of soda, or Glauber salts remains. This new combination of soda with sulphuric acid is dissolved by mixing potashes, or, still better, chalk with the Glauber salts, and exposing the mixture to heat in a reverberatory furnace until it begins to grow soft; when it is drawn out in iron or stone plates and broken into pieces. Instead of chalk, four-fifths chalk and two-fifths carbon may be added to the Glauber salts. The carbonic acid, which existed in the chalk combined with the lime, or in the other process, was formed by the oxygen, which it drew from the sulphuric acid, unites, in this process, with the soda, while the lime, from which the carbon has likewise withdrawn its oxygen, and which is hereby restored to a metallic state, becomes sulphuret of calcium, which is with difficulty dissolved in water. Thus a method was at once found, instead of obtaining the soda from abroad, of getting it in the country itself, and while, during the interruption of commerce the price of soda had risen to one hundred and sixty francs per kilogramme, it sank immediately to eighty francs for pure carbonate of soda, and at a later period even to twenty francs.

The manufacturers of soda found the chlorine gas produced in the preparation of natron or soda very troublesome, and they do so still. Only very recently has its value been discovered. Wherever this gas escapes from the furnaces and chim-

neys of the above-mentioned manufacturers, it spreads desolation in the vegetable world, causing every leaf, and every blade of grass to wither. Even to animals and men it is injurious; yet its fatal influence can be more readily averted from man than from plants. The buildings used for the manufacture of soda from common salt and sulphuric acid are erected in uninhabited spots; and in southern France they are placed among the mountain ravines of Septieme, from whose barren soil hardly a blade of grass springs.

Long before the suspension of trade, about 1791, the same chemist, Le Blanc, who some years afterwards opened to all the cheap method, above described, of obtaining soda, erected a soda-factory at St. Denis, and was aided with a considerable sum in this useful undertaking by the Duke of Orleans. Many other countries besides France have now taken part in this useful business; and to mention here only those of Germany, there are soda-factories at Schoenbeck near Magdeburg; and even those at Wolfrathshausen near Munich, are not inferior in the amount they yield to the French.

In the preparation of soap, by boiling fat with a solution of lye, the lye, under the influence of heat, combines with the fatty acids, oleic, stearic, and margaric acids, forming oleates, stearates, and margarates of the alkali. For the polaric opposite of the alkali of the lye is the acid; every substance with which an alkali or an alkaline earth is to be chemically united, must combine with it in the relation of an acid. In those countries, where the olive-tree flourishes and ripens its fruit, the oil has been used for ages, instead of animal fat, in the preparation of soap. Formerly, before Russia had closed its borders against foreign importation, England drew from that country hundreds of thousands of cwt. of tallow and flax-seed oil; now her ships bring her hundreds of thousands of cwt. of palm and cocoanut oil, and thus as good, and even a finer, material for soap is afforded than the Russian tallow.

Some plants produce a soapy substance, which, in its composition and properties is very similar to our artificial soap. Especially is this soapy substance found in

the sap of the roots as well as of the other parts of the common soap weed (*Saponaria officinalis*), and of a *Begonia*, which is an article of trade under the name of Egyptian soap root, and the slimy soapy sap of which is recommended for the washing of sheep before shearing, and which has been found effective.

*An Eye-manufactory on a large scale.*—The eye is the light of the body; and if the eye is not clear and loses its brightness, then is the whole body dark. A wondrous organ is the eye in its whole structure, and in all its powers. Through the little round opening (the pupil) which the iris, or *rainbow membrane*, surrounds like a blueish or brownish circle of rays, one can look into the inmost, farthest wall of the eye-chamber. That which glimmers toward us out of this depth, with an almost silver white light, and which, in the eye of the cat, and of many other animals, sheds forth a faint light even at night,—that is a visible coming forth of the inmost life of our material nature, everywhere else concealed from us. It is the marrow of the seeing or optic nerve, which there spreads itself out with its delicate little tubes, as the texture of the net-work membrane or retina. Nowhere else but at this part of the body, does a nerve, a direct efflux of the mass of the brain and spinal marrow lie disclosed to our sight. The brain and spinal marrow lie deeply enclosed in their bony vaults, and under the cover of the flesh and skin; and in all the other members, the tender threads of the nerves are concealed by the flesh of the muscles and the manifold textures of the skin. It is here, in the eye, that the inner light of the body meets the outer light of the world, where the outward becomes recognisable to the inward, and the inward to the outward.

When we consider the structure of the eye somewhat more closely, we find that the glimmer of light which is perceptible to us, coming from the retina at the remotest back-ground of the eye, and the ray of light, which, coming from without, falls in upon the nervous marrow of the retina, and there produces vision, must pass, not only as in the clear water of a lake, through a single transparent medium; but as in the case of the achromatic glasses, hereafter to be mentioned, through

several. For, first there is the transparent watery-clear horn membrane (*cornea*), whose arched window is ingeniously fitted into the opaque, white, hard membrane of the eye; behind this, between it and the circular iris, which is open in the middle, is a watery fluid which flows out through the open centre (the pupil) of the iris, and also behind this, between it and the crystalline lens, so that the iris, spread out in this fine fluid, can regulate its motions unobstructed, extending or contracting itself, and thus, when the light is too strong, can diminish and close the entrance-gate of the seeing opening, or pupil, and when less light is present, can enlarge it. On the other side of this front chamber of the eye, and its watery fluid in which the iris floats, is the firmer crystalline lens; in the human eye, and in that of the more perfect animals, this lens is a ball, flattened somewhat towards the back part: in the eye of the fish, when it has become white and hard by being cooked, it is almost entirely round. This, too, in a perfect eye is transparent, as well the half-fluid mass, the so-called glass substance (or *vitreous humour*) which fills up the whole back-ground of the eye, and in which the crystalline lens lies embedded, like the kernel of a nut in the cup of the half-open shell. A ray of light, when it falls from without in upon the sensitive retina and there produces vision, must, besides the fine membrane, which, like a capsule, surrounds the crystalline lens and the membranous vitreous body, pass through four transparent media of various thickness; the cornea, the watery (or *aqueous*) humour, the crystalline lens and vitreous substance.

This is the way in which life everywhere goes to work. It is simply one indwelling soul, which forms and moves the body, and recognises and perceives the external world by means of the body; but this one soul generates and fashions for itself in the substance of its corporeality a great variety of members, every one of which represents on a small scale the relation of the soul to its body, of the Creator to his creation; while the soul, in the realm of being appropriated to it, is everywhere the ground-tone, the key-note, but He, the Creator, is All in all.

(To be continued.)



## FAMILIAR CONVERSATIONS ON INTERESTING SUBJECTS.

"If you wish, Clara, to resume the subject of our conversation upon flowers, (see page 111, vol. iv.), come into my room, in about an hour from this, and I will be ready to attend to you."

"Thank you, mother; I shall be very glad to do so; for the more I learn of this delightful study, the more interesting it becomes."

Scarcely had the hour passed, when a gentle rap at the door, accompanied by the words, "May I come in, mother?" informed Mrs. Wilson that the appointment was not forgotten. Permission was granted; and soon after Mrs. Wilson, handing Clara a flower that had been pressed between the leaves of a book, asked if she knew what it was.

"Oh! yes, mother, it is a lilac," was the reply.

"Can you tell me its class and order?"

"It has two stamens and one pistil; therefore, it must be of the class Di-andria, order Mono-gynia."

"That is correct: this class has three orders; and although somewhat more extensive than the class Mon-Andria, is still somewhat limited."

"The lilac is a very common flower though, mother."

"Yes; but although so common it is nevertheless an exotic."

"What is an exotic, mother?"

"A plant brought from some other country.—Its botanical name is *Syringa*; which is said to be derived from a Turkish word which signifies pipe."

"It does not look much like a pipe at all events, mother."

"Not much, Clara; but the stems of pipes were sometimes made of its roots. Examine the corolla, and tell me of how many petals it is composed?"

"Of four."

"Are you sure, Clara? look again."

"There are four, I think, mother."

"It is four parted; but if you examine it closely you will perceive it is all in one piece."

"Oh, yes, mother; I see now they are not distinct, like the petals of a lily."

"Such flowers are said to be mono-petalous; when composed of more than one piece, it is poly-petalous."

"There is another difference I see between this flower and some others which I have examined, mother."

"What is it?"

"Its stamens are fastened on the corolla, and not on the receptacle."

"That is the case with most mono-petalous flowers; where there are several petals they are generally attached to the receptacle."

"Are there many species of this plant, mother?"

"There are, I believe several; but those most common to us, are the vulgaris, or common, which has leaves shaped like a heart; and the Persica, or Persian, with lanceolate leaves."

"What kind are they?"

"Long and narrow; the form in which these blossoms are crowded together, is called a thyse. Another well-known plant of this class is Sage; scientifically called *Sálvia*, from *Salvo* to save; this genus contains one hundred and fourteen species."

"A pretty large family, isn't it, mother?"

"Yes; tolerably large: but you have seen sage in blossom, Clara, and know that the form of the corolla is entirely different from that of the lilac?"

"Oh yes, mother; they are not at all alike; I should hardly have supposed they belonged to the same order and class."

"It is because they are alike in regard to the number of stamens and pistils they have, that causes them to be classed together. Flowers of this kind, are called labiate; and are mostly placed in the class Di-dynamia."

"That is the 13th class, and has four stamens, two long and two short; isn't it mother?"

"Yes, and as the sage has only two stamens, it cannot therefore be placed in this class."

"What is the name of that species of sage which grows in our garden, mother?"

"The officinalis species."

"Isn't clary a species of sage too, mother?"

"Yes; its leaves you know are larger than the common sage; and it possesses more medicinal virtue. There is also a little plant, which grows in shady places, and leaves a small white blossom belonging to this class."

"What is it called, mother?"

"Its common name is Enchanted Nightshade; scientific, *Circea*. This little plant is remarkable for the symmetry of its parts, having two stamens, two petals, a calyx with two divisions, a capsule with two cells, each containing two seeds."

"I don't exactly understand what a capsule is, mother, without it is another name for the pericarp."

"Linnæus divides pericarps into nine classes, of which the capsule is the first; the word signifies chest, or casket. The pericarp of the lily is a capsule."

"And all others, I suppose, of similar construction?"

"Yes. The *Veronica*, or *Speedwell*, is another plant of this class; and after the opinion of eminent botanists, this genus, which is very interesting, is said to contain about seventy. The last which I shall mention as belonging to this class is the *Olive-tree*, which travellers say is still quite common on the Mount of Olives, and other parts of Palestine."

"What plants are found in the second order of this class, mother?"

"They are not very numerous; but for example, we may take the sweet smelling spring grass, which blossoms in May, and which gives to new-mown hay its delightful odour."

"How glad I shall be, mother, when spring comes, so that I can collect flowers for examination! I think this study will be doubly interesting then."

"So it will, Clara; and I hope you will find much delight in thus examining these 'tokens of God's love.'"

"You said this class contained three orders, didn't you, mother?"

"Yes; as an example of the order *Trygynia* we may take black pepper, or botanically, *Piper Nigrum*."

"How many orders does the class *Triandria* contain, mother?"

"Only two: *Mono-gynia*, one pistil; *Di-gynia*, two pistils. I will not stop to describe plants of this class; for as they are found among our earliest garden flowers, you will soon have an opportunity of analyzing them, which will afford you a much better idea of them than any description I can give you. Now, tell me the name of the fourth class?"

"*Tetra-andria*, four stamens."

"This class has three orders. *Mono-gynia*, one pistil; *Di-gynia*, two pistils; and *Tetra-gynia*, four pistils."

"None of the third order, then?"

"I believe not; plantain and dogwood-tree belong to the first order; besides some very pretty wild flowers; the *Hamelis*, or *Witch Hazel*, belongs to the second order."

"Does it not grow in the woods, mother?"

"Yes; and bears yellow flowers, which are often in blossom, late in the year, after the tree has lost its leaves."

"I have seen it many a time, mother."

"I dare say you have. What is the name of the fifth class?"

"*Pent-andria*, five stamens."

"In this class we have six orders; *Mono-gynia*, one pistil; *Di-gynia*, two pistils; *Tri-gynia*, three pistils; *Tetra-gynia*, four pistils; *Penta-gynia*, five pistils; and *Poly-gynia*, thirteen pistils."

"Then, there are no plants in this class with six, seven, eight, nine, or ten pistils?"

"No; this class is said to embrace more than a tenth part of all known species of plants."

"It is not very difficult to find specimens of it, then, mother?"

"No; in the first order we find many important vegetables, such as the potato, tomato, and egg-plant; tobacco is also found here."

"That is not very useful, mother?"

"Not as it is generally used, Clara; but all the works of God are of use in some way or other, though not always manifest to us. The generic name of this plant is *Nicotiana*; so called from *Nicot*, who about the middle of the sixteenth century, carried it to Europe, and presented it to *Catharine de Medicis*, Queen of France, as a plant which was possessed of remarkable virtues. It is said that King James had such a dislike to it, that he wrote a work against it, called, '*A Counterblast to Tobacco*.' But it is almost dinner-time, so we must drop the subject for to-day."

DOING GOOD.—Usefulness is confined to no station, and it is astonishing how much good may be done, and what may be effected by limited means, united with benevolence of heart and activity of mind.



## PROPERTIES OF MATTER.

MATERIAL substances have two kinds of properties — physical and chemical; the former of which comprehends natural philosophy, the latter chemistry.

The physical properties are of two kinds, general and secondary. Properties which are common to all bodies, we call general; those observable in a few only, we call secondary. Among the general, we have extension, impenetrability, mobility, extreme divisibility, gravitation, porosity, and indestructibility.

Extension is the property of occupying a certain portion of space. By impenetrability, no two portions of matter can occupy the same space. These two constitute matter.

Matter cannot move of its own accord; but when acted upon under certain circumstances is possessed of extreme mobility; as, for instance, a wheel turning round, water when acted upon by heat, and the act of throwing a stone.

Matter is capable of being divided in an extreme degree of minuteness, so much so as to defy all attempts at arriving at the least particle, molecule, or atom. A grain of gold can be made to cover a surface of fifty square inches, by hammering; but by a chemical process, it can be made to extend twelve times as far, or six hundred square inches. One grain of iron, dissolved in an acid, and diffused through water, can be detected by proper tests in a twenty-fourth millioneth part.

By gravity, or terrestrial attraction, we understand a body to fall straight to the earth, when let fall at any distance from its surface; such as letting a stone fall from the top of a house, or of a high mast, or balloon. There is no particle of matter, however small, but has gravity; therefore, the more particles there are, the greater the gravity of the substance will be.

The particles of bodies are so arranged as to be what is called porous; that is, the particles do not unite so closely but that they leave a certain portion of space between them, as can be seen very readily in a sponge. In some substances, although we cannot see the pores, yet we can demonstrate their existence, by the reduction in size which takes place when a body the

most compact is subjected to mechanical pressure or heat. This brings us to the conclusion that the atoms of which a body is composed do not touch at every point; because, if the reverse was the case, we would have no such thing as porosity. When a body expands, as steam for instance, the distance between its particles is increased: and when this steam, by the action of cold, is contracted into matter again, its particles contract and coalesce.

By indestructibility, we mean that matter never ceases to exist. This, at first view, may appear paradoxical, but it is true; for, although coal, on burning in the fire, may seem to waste away; or water, when heated, to dissipate, yet such is not the fact; they only change their place. New chemical combinations are formed, and the weight of whatever may have been produced, is equal to that which has been lost.

Among the secondary properties of matter, are observed opacity, transparency, softness, hardness, elasticity, colour, density, solidity, fluidity, and others of a like nature, which condition in bodies depends on two opposite causes, namely, cohesion and repulsion.

From what we have seen of the divisibility of matter, and the force used to produce it, we find the substance of solids and fluids made up of a number of very minute particles, adhering so closely together as to constitute larger masses; and in order that these should cohere, they must have mutual attraction. This cohesion, molecular attraction, or attraction of particles, or molecules, exerts its influence at insensible, or uncertain, and minute distances. It enables similar molecules to cohere, and keep themselves in that condition. This attraction is greater in some than in others; and those substances which are easiest torn or broken across, have less of this molecular attraction, and consequently are more porous in their structure, as we all know that wood is easier broken than iron, paper than wood.

All matter would fly together and co-adhere, if it was not for a certain principle or influence contrary to attraction, called repulsion. This repulsion is said to be owing to caloric or latent heat, which somehow or other is attached to the atoms,

causing them to repel one another. Cohesion predominates more in solids than in fluids, and repulsion in fluids than in solids. In *aëriiform* substances, cohesion seems to be wanting altogether, and they are easily compressed. Fluids, on the contrary, do not yield perceptibly to ordinary pressure. In these last, repulsion is counterbalanced by cohesion.

Matter is subject to another kind of attraction, called chemical attraction, or affinity, which, like cohesion, acts at uncertain and insensible distances, and thus differs from gravity. A piece of marble is an aggregation of smaller portions, attached to one another by cohesive attraction. The parts so attached are called *integrant particles*; each of which, however minute, being as perfect marble as the mass itself. These *integrant particles* consist of two substances—lime and carbonic acid—different from one another and from the marble, but united by chemical attraction. They are the component or constituent parts of the marble. The *integrant particles* of a body are therefore aggregated together by cohesion; the component parts by affinity.

Bodies owe their chemical properties to affinity, the chemical phenomenon of which is produced by the operation of this principle. This chemical affinity has more or less to do with every substance on this earth, and under certain modifications. If A, B, C, be three different substances, it is often found that B and C evince no affinity for one another, and therefore do not combine; A, on the contrary, has an affinity for B and C, and can enter into separate combinations with them both; but A has a greater affinity for C than B; therefore, if we bring C in contact with a compound of A and B, A will leave B, and unite in preference with C. The union of two substances is called *combination*; and its result is the formation of a new body, endowed with properties peculiar to itself, and different from those of its constituents. The change is frequently attended by the destruction of a previously existing compound, and in that case *decomposition* is said to be effected. The composition of bodies is determined in two ways—by analysis and synthesis. By analysis, the elements of a compound are separated from one another, as when water

is separated by the agency of galvanism into oxygen and hydrogen. By synthesis, they are made to combine, as when oxygen and hydrogen unite by the electric spark and generate a portion of water.

## RIGHT VIEWS OF EDUCATION.

BY D. P. PAGE.

EVERY teacher, before he begins the work of instruction, should have some definite idea of what constitutes an education; otherwise he may work to very little purpose. The painter, who would execute a beautiful picture, must have beforehand a true and clear conception of beauty in his own mind. The same may be said of the sculptor. That rude block of marble, unsightly to the eyes of other men, contains the god-like form, the symmetrical proportion, the life-like attitude of the finished and polished statue; and the whole is as clear to his mental eye before the chisel is applied, as it is to his bodily vision when the work is completed. With this perfect *ideal* in the mind at the outset, every stroke of the chisel has its object. Not a blow is struck, but it is guided by consummate skill; not a chip is removed, but to develop the ideal of the artist. And when the late unsightly marble, as if by miraculous power, stands out before the astonished spectator in all the perfection of beauty,—when it almost breathes and speaks,—it is to the artist but the realization of his own conception.

Now let the same astonished and delighted spectator, with the same instruments, attempt to produce another statue from a similar block. On this side he scores too deep; on the other he leaves a protuberance; here by carelessness he encroaches upon the rounded limb; there by accident he hews a chip from off the nose; by want of skill one eye ill-mates the other; one hand is distorted as if racked by pangs of the gout, the other is paralyzed and death-like. Such would be his signal failure. Thus he might fail a thousand times. Indeed, it would be a matter of strange surprise if in a thousand efforts he should once succeed.

Now the difference between the artist and the spectator lies chiefly in this,—the one knows beforehand what he means to do; the other works without any plan.



The one has studied beauty till he can see it in the rugged block; the other only knows it when it is presented to him. The former, having an ideal, produces it with unerring skill; the latter, having no conception to guide him, brings out deformity.

"What sculpture is to the block of marble," says Addison, "education is to the human soul;" and may I not add, that the sculptor is a type of the true educator,—while the spectator, of whom I have been speaking, may aptly represent too many false teachers who without study or forethought enter upon the delicate business of fashioning the human soul, blindly experimenting amidst the wreck of their heaven-descended material, maiming and marring, with scarcely the possibility of final success—almost with the certainty of a melancholy failure?

In other things besides education men are wiser. They follow more the teachings of Nature and of common sense. But in education, where a child has but one opportunity for mental training, as he can be a child but once,—where success, unerring success, is everything to him for time and eternity, and where a mistake may be most ruinous to him,—in education, men often forget their ordinary wisdom and providence, and commit the most important concerns to the most incompetent hands. "The prevailing opinions," says Emerson, "in regard to this art are such as the common sense of mankind and the experience of centuries have shown to be absurd as to every other art and pursuit of civilized life. To be qualified to discourse upon our moral and religious duties, a man must be educated by years of study; to be able to administer to the body in disease, he must be educated by a careful examination of the body in health and in disease, and of the effects produced on it by external agents; to be able to make out a conveyance of property, or to draw a writ, he must be educated; to navigate a ship, he must be educated by years of service before the mast or on the quarter-deck; to transfer the products of the earth or of art from the producer to the consumer, he must be educated; to make a hat or a coat, he must be educated by years of apprenticeship; to make a plough, he must be educated; to make a nail, or a shoe for a horse or an ox, he

must be educated;—but to prepare a man to do all these things;—to train the body in its most tender years, according to the laws of health, so that it should be strong to resist disease; to fill the mind with useful knowledge, to educate it to comprehend all the relations of society, to bring out all its powers into full and harmonious action; to educate the moral nature, in which the very sentiment of duty resides, that it may be fitted for an honourable, and worthy fulfilment of the public and private offices of life; to do all this is supposed to require no study, no apprenticeship, no preparation!"

Many teachers, therefore, encouraged by this unaccountable indifference in the community, have entered the teachers' profession without any idea of the responsibilities assumed, or of the end to be secured by their labours, aside from receiving, at the close of their term, the compensation for their service in a pecuniary sense. And even many who have entered this profession with good intentions, have made the most deplorable mistakes from a want of an adequate idea of what constitutes an education. Too often has educating a child been considered simply the act of imparting to it a certain amount of knowledge, or of "carrying it through" a certain number of studies, more or less. Education has too frequently been held to be a cultivation of the intellectual to the neglect of the moral powers; and the poor body, too, except among savages, has had but little in its privileges or benefits. In a very large number of our schools, the physical and the moral have both been sacrificed to the intellectual. Even some of our public speakers have dwelt upon the necessity of *intelligence* to the perpetuity of our free institutions, scarcely seeming to be aware that intelligence, without moral principle to direct and regulate it, might become the very engine through which evil men might effect our overthrow. Who has not seen that an educated man without virtue is but the more capable of doing evil? Who does not know that knowledge misdirected, becomes, instead of a boon to be desired, a bane to be deprecated?

From what has been said, I place it among the highest qualifications of the teacher that he should have *just views of*

*education.* I consider it all-important that he should have a well-defined object at which to aim, whenever he meets a young mind in the transition state. He should have an *ideal* of a well-educated human soul, tenanted by a healthy, well-developed human body; an ideal which he at once and systematically labours to reach, as does the sculptor when he commences his work upon the quarried marble. "What is it to educate a human being aright?" should be one of the first questions the candidate for the teacher's office should ask himself with the deepest seriousness. I say the *candidate*; for this question should be settled, if possible, *before* he begins work. It is a great question, and he may not be able to answer it in a day. Let him consult the dictates of his own mind,—let him consult the teachings of experience and of wisdom, as they are to be found in the writings of Milton, Locke, Wyse, Cousin, Brougham, and others. Let him, enlightened by all this, carefully observe human nature around him; consider its tendencies, its wants, and its capabilities, and after a patient survey of all the truth he can discover upon the subject, let him come to an honest conclusion as to what is a correct answer to the query with which he started—"What is it to educate a human being aright?"

The conclusions of the honest and intelligent inquirer after the truth in this matter, will be something like the following:—That education is development; that it is not instruction merely—knowledge, facts, rules—communicated by the teacher, but it is discipline, it is a waking up of the mind, a growth of the mind,—growth by a healthy assimilation of wholesome aliment. It is an inspiring of the mind with a thirst for knowledge, growth, enlargement,—and then a disciplining of its powers so far that it can go on to educate itself. It is the arousing of the child's mind to think, without thinking for it; it is the awakening of its powers to observe, to remember, to reflect, to combine. It is not a cultivation of the memory to the neglect of everything else; but it is a calling forth of all the faculties into harmonious action. If to possess facts simply is education, then an encyclopædia is better educated than a man.

It should be remarked, that though

knowledge is not education, yet there will be no education without knowledge. Knowledge is ever an incident of true education. No man can be properly educated without the acquisition of knowledge; the mistake is in considering knowledge the *end*, when it is either the *incident* or the *means* of education. The discipline of the mind, then, is the great thing in intellectual training; and the question is not, how much have I acquired?—but, how have my powers been strengthened in the act of acquisition?

Nor should the intellectual be earlier cultivated than the moral powers of the mind. The love of moral truth should be as early addressed as the love of knowledge. The conscience should be early exercised in judging of the character of the pupil's own acts, and every opportunity afforded to strengthen it by legitimate use. Nor should the powers of the mind be earlier cultivated than those of the body. It is the theory of some, indeed, that the body should engross most of the attention for several of the first years of childhood. This, I think, is not Nature's plan. She cultivates all the powers at once,—the body, mind, and heart. So should the teacher do. "Education," in the pertinent language of Mr. Fox, "has reference to the *whole man*, the body, the mind, and the heart; its object, and, when rightly conducted, its effect, is, to make him a complete creature after his kind. To his frame it would give vigour, activity, and beauty; to his senses, correctness and acuteness; to his intellect, power and truthfulness; to his heart, virtue. The educated man is not the gladiator, nor the scholar, nor the upright man, alone; but a just and well-balanced combination of all three. Just as the educated tree is neither the large root, nor the giant branches, nor the rich foliage, but all of them together. If you would mark the perfect man, you must not look for him in the circus, the university, or the church, exclusively; but you must look for one who has '*mens sana in corpore sano*'—a healthful mind in a healthful body. The being in whom you find this union, is the only one worthy to be called educated. To make all men such, is the object of education."

I have dwelt thus fully on this subject, because it is so obvious that egregious



mistakes are made in education. How many there are who are called "good scholars" in our schools, of whom we hear nothing after they go forth into the world! Their good scholarship consists in that which gives them no impulse to go on to greater attainments by themselves. Their learning is either that of *reception*—as the sponge takes in water—or that of mere memory. Their education is not discipline; it kindles none of those desires which nothing but further progress can satisfy; it imparts none of that self-reliance which nothing but impossibilities can ever subdue. While these are pointed out by their teachers as the ornaments of their schools, there are others, known as the heavy, dull, "poor scholars," in no way distinguished but by their stupidity,—of whom no hopes are entertained because of them nothing is expected,—who in after-life fairly outstrip their fellows and strangely astonish their teachers. Almost every teacher of fifteen years' experience has noticed this. Now why is it so? There must have been somehow in such cases a gross misjudgment of character. Either those pupils who promised so much by their quickness, were educated wrong, and perhaps educated too much, while their teachers unwittingly and unintentionally educated their less distinguished companions far more judiciously; or else nature in such cases must be said to have been playing such odd pranks that legitimate causes could not produce their legitimate effects. We must charge nature as being extremely capricious, or we must allege that the teachers entirely misunderstood their work, failing where they expected most, and succeeding, as if by chance—almost against their will, where they expected least. I incline to the latter alternative; and hence I infer that there is such a thing as teaching a mind naturally active too much—exciting it too much,—so that it will prematurely exhaust its energies and gladly settle back into almost imbecility; and that there is such a thing as leaving the mind so much to its own resources, that without dazzling the beholder like the flash of the meteor when it glares upon the startled vision, it may be silently gathering materials to support the more

enduring light of the morning star which anon will arise in majesty and glory.

It will be well for our youth when our teachers shall so understand human nature, and so comprehend the science and the art of education, that these mistakes shall seldom occur; and when he who tills the nobler soil of the mind, shall, with as much faith and as much certainty as he who tills the literal field, rely upon the fulfilment of heaven's unchangeable law: "Whatsoever a man soweth, that shall he also reap."

### "THAT BOY I CAN TRUST."

I once visited a large public school. At recess, a little fellow came up and spoke to the master; as he turned to go down the platform, the master said, "*That is a boy I can trust. He never failed me.*"

I followed him with my eye, and looked at him when he took his seat after recess. He had a fine, open, manly face. I thought a good deal about the teacher's remark. What a character had that little boy earned. He had already got what would be worth more to him than a fortune. It would be a passport into the best office in the city, and what is better, into the confidence and respect of the whole community at large.

I wonder if the boys know how soon they are *rated* by older people; every boy in the neighbourhood is known and opinions are formed of him; he has a character, either favourable or unfavourable. A boy of whom the master can say, "I can trust that boy, he *never* failed me," will never want employment. The fidelity, promptness and industry which he shows at school are in demand everywhere, and are everywhere prized. He who is faithful in little, will be faithful also in much.—Be sure, boys, that you earn a good reputation at school. Remember, you are just where God has placed you, and your duties are not so much given you by your teacher or your parents, as by God himself. You must render an account to them, and you also will be called to render an account to Him. Be trusty—be true.

## EASTERN RAMBLES AND REMINISCENCES.

### RAMBLE THE TWENTY-EIGHTH.

ODEIUM OF PERICLES — THEATRE OF  
BACCHUS—ODEIUM OF REGILLA—MU-  
SEUM — MONUMENT OF PHILOPAPUS —  
PRISONS AND TOMB OF SOCRATES—THE  
PYNX — PLEASANT REFLECTIONS AND  
DISAGREEABLE QUESTIONS — MOUNT  
LYCABETTUS—THE SLIDING STONE —  
THE HILL OF MARS, OR AREOPAGUS—  
ST. PAUL'S PREACHING—THE TRIBUNAL  
OF THE AREOPAGITÆ — HISTORICAL  
ASSOCIATIONS, AND DERIVATION OF ITS  
NAMES—ASCENT OF PENTELICUS, AND  
VIEW FROM ITS SUMMIT.

"See yonder hallow'd fane! the pious work  
Of names once famed, now dubious or forgot,  
And buried 'midst the wreck of things which  
were;

There lie interr'd the more illustrious dead."

ROBERT BLAIR.

"Ye cliffs, in hoary grandeur piled  
High o'er the glimmering dale;  
Ye woods, along whose windings wild  
Murmurs the solemn gale."

DR. BEATTIE.

The sun had just smiled his first smile upon the earth, and Nature gratefully welcomed him with a joyful chorus of sweet-throated birds, when we emerged from our hotel to examine the place yet unvisited by our party on the south and south west sides of the Acropolis.

Passing many of the spots we had seen the day before, and along the street of the tripods, we arrived at the site of the Odeium\* of Pericles, which is in the neighbourhood of the Theatre of Bacchus. The roof of this structure is said to have been formed of the masts and yards of the Persian ships, which were so arranged that the roof was pointed like a tent.

Near to the Odeium of Pericles is the site of the Theatre of Bacchus, or, as it is frequently termed, the Dionysiac Theatre, which is situated near to the south-east angle of the Acropolis. It is said to have been built 500 years before Christ, and its arena is the spot where the festivals called

the Dionysiac were held in honour of Bacchus. These festivals were similar to those held by the Egyptians in honour of Isis, and were observed with great splendour and much ceremony. The vast arena at times was filled with the Chori, who contested in music and poetry for a prize tripod, to be afterwards placed upon one of the elegant Temples in the street of the tripods, as a memento of their victory.

The 30,000 spectators who were assembled to see the worshippers of Bacchus dressed in fawn's skins, fine linen, and mitres; crowned with ivy, vine and fir garlands; and bearing pipes, flutes, drums and thyrsi, no doubt made Dicæarchus say that it was the most beautiful theatre in the world. True he had not seen them all, and perhaps he may have been a votary of Bacchus, and therefore the actors may have possessed an additional charm for him as they imitated Pan, Silenus, and the Satyrs, shrieking aloud, *Evœ! Bacche! Io! Io! Evœ! Iacche! Io Bacche! Evœ!* dancing, riding upon asses and goats, and nodding their heads incessantly; perhaps he saw double, and hence his enthusiasm. Dicæarchus may, in modern *parlance*, have been "a good fellow;" we question him not, but we must say that he considerably overrated its beauties. At the present time it is a mass of huge stones, and sloping dust, so that if a bold traveller attempts to pick out a relic of former days in the shape of a piece of stone that never belonged to the temple, he is covered with a cloud of dust, too profuse, but not too welcome.

In former times, when the Theatre of Bacchus was in great repute, there was a beautiful portico on the western part of the edifice, which served as a shelter for the Chori before they contested in the arena.

There are some other sites that we must hasten by, because their identity is disputed, and we cannot afford the time to examine the claims of either party of disputants.

The next spot of interest that we visited was the Odeium of Regilla, or the theatre of Herodes Atticus. It is more commonly known by the latter name, but it is more correctly called by the former, which was given to it in honour of his deceased wife, and as it could not properly

\* Odeium is derived from *Ode* (Ὀδή), a song; and means a music-hall.





VIEW FROM PENTELICUS.

be called a theatre,\* we must regard it as the Odeium or Music-hall of Regilla. The present ruins consist of some seats cut out of the rock on which the Acropolis is built, and a series of arches in three tiers, crumbling away in many parts, and decked with wild flowers and weeds, that

“Lend to the gale a rich perfume,  
And grace the ruin in its fall.”

Philostratus states that the roof was of cedar, and if this be true, it must have been a splendid building for music. Here

\* The word theatre is derived from the Greek *theatron* (θεατρον), which is derived from *theaomai* (θεαομαι). I behold; and therefore means a place for seeing.

8000 people have often been assembled to listen to dramatic recitations and music. Now all are swept away, save the walls which are mouldering fast, and

“Midst thine arches, frowning, lone,  
Stern desolation rear his throne:  
And silence, deep and awful, reign,  
Where echoed once the choral strain.”

Leaving the Odeium we crossed the modern road to Sunium and ascended the Museum, which is a hill opposite to the Acropolis, where Themistocles made a promenade for the Athenians, and where we may now see the remains of the ancient city-walls which enclosed part of the hill. The chief object of attraction in this spot, independent of the fine view of the neighbouring places, is the ruined monument of the Syrian Consul, Caius Julius Antiochus Philopapus, the grandson of Antiochus IV. It is built of white marble, and has a fine bas-relief upon the lower part, in honour of the Emperor Trajan. It is much mutilated, and so are the statues above, which we are told by Pausanias, represented the consul himself, his father, and his grandfather. They were placed



in niches, but as the left wing of the building is destroyed we only see two of them now.

As we descended the hill to the north, the guide pointed out some excavations in the side of the Museum, said to be the prisons of Socrates. They are merely three chambers cut in the rock, one of them having a hole above; this chamber is said to be the prison of Socrates, where he drank the poison, the hole being used to lower his food during his imprisonment. Near to the prisons, as they are called, is a solitary tomb, which is pointed out as that of the philosopher.

Proceeding a few steps towards the north, we arrived at the celebrated Pnyx,\* which was the place used for the great meetings of the people in ancient times, and where Demosthenes, Solon, Aristophanes, and other orators no less celebrated in the palmy days of Athens, have often addressed them. The *bema* or pulpit of stone is turned from the sea towards the country, but in the days of Themistocles it faced the sea, so that the Athenians might be reminded of their maritime power. The area of this interesting spot is nearly 13,000 square yards, and the seats below, the steps leading to the *bema*, and the *bema* itself, are all hewn out of the solid rock.

Who could visit such a spot, and not dwell upon their early days when the names of some of the wisest of the Greeks were 'as familiar as household words' to them?

Who could gaze unmoved upon that *bema* where Demosthenes formerly harangued the assembled multitudes? If such a man there be, he must be strange indeed.

I like not your enthusiast in classic spots, one who quotes Horace, Ovid, Virgil, Pausanias, Pliny, Cæsar, Thucydides, and a host of others, upon every occasion; such an one is a bore; for if you only mention the Acropolis, or indeed any other place, he immediately says, "Ah! yes; you remember those lines of Horace where he says"—but I will not inflict them upon the reader; no doubt they were very good and appropriate; we will not dispute the matter. The matter-of-fact

traveller is a bore, the pedant is a bore, and so you will find a host of other people that meet you at the ruins or on the sites of remarkable places along the shores of the Great Sea. If you are seated upon a prostrate column of some once celebrated temple, indulging in the society of solitude, for as Byron remarks,

"There is society where none intrudes;"

and your thoughts are carrying you back back to the time when the surrounding scene resounded with the busy hum of commerce, of war, or of triumph and rejoicing; it is particularly annoying to be interrupted in your pleasant reflections by some such question as, "Can you tell me how many feet long this temple is, how many columns it had, and the dimensions of each column?" "Will you be kind enough to inform me, sir, if this is the place where the temple of Venus Pandemus and Peitho once stood, because Euripides stated that it stood very near to the Acropolis, while Apollodorus stated, that it was in or near the ancient Agora?" It matters little to me how long the columns were, or where the temple really did stand; but it is a nuisance to be interrupted in pleasant reflections—dreamy pictures of the past.

Descending from the *bema*, we once more stood in the high road to the Peiræus, and before us rose Mount Lycabettus, which Minerva is said to have thrown down to serve as an outwork to the Acropolis. It is a mere hill crowned by an observatory, and at the base is a mass of polished limestone, part of the mount itself, where the Grecian women slide down, imagining that this will cure sterility. Although this modern Eleusinian ceremony is usually performed at night, yet there were twenty or thirty of them playing follow-my-leader down the rock, polished by the frequent visits of similar parties.

Turning our backs upon Lycabettus, we crossed the road, and ascended some rudely cut steps in the limestone rock of the Hill of Mars in the Areopagus, which formerly stood in the centre of Athens. This is the place where St. Paul addressed the Athenians so eloquently, when he said, "Ye men of Athens, I perceive that in all things ye are too superstitious. For as I

\* For a view of this remarkable place see *Family Tutor*, vol. ii., p. 186, showing the Acropolis in the distance.



passed by, and beheld your devotions, I found an altar with this inscription, TO THE UNKNOWN GOD. Whom therefore ye ignorantly worship, him declare I unto you," Acts xvii. 22, 23. There is not any spot in the neighbourhood which could have been so well adapted for St. Paul to address the multitude from as the Areopagus, as it commanded a view of the temples to which he referred in his speech when he told them that the "Lord of heaven and earth dwelleth not in temples made with hands," Acts xvii. 24. We may imagine the swarms of people below, even crowding as far as the Pynx, anxious to hasten to the new doctrine, for we are told that "all the Athenians and strangers which were there spent their time in nothing else, but either to tell or to hear some new thing." Let us also imagine the temple of Mars to St. Paul's right hand, but still before him, and the Epicureans and Stoics surrounding him upon the platform of the Areopagus, as he pointed with his left hand to the Phidian statue of Minerva towering above the Parthenon, and said, "We ought not to think that the Godhead is like unto gold, or silver, or stone, graven by art and man's device," Acts xvii. 29. Perhaps near to St. Paul was Dionysius the Areopagite, and the woman Damaris, with a few others that believed in the matters he expounded.

In addition to the interest attached to the Areopagus from its connection with sacred history, there are other associations which are pleasing to the scholar and historian. It was on this spot that the High Criminal Court of Athens was held, composed entirely of the ex-archons, whose characters were unexceptionable; these were called the *Areopagite*, or Areopagites. If you walk up the sixteen stone steps, cut in the rock at the south-east angle, you will see a bench of stone at the top, which is also cut from the solid rock, and forms three sides of a quadrangle facing the south; this is the bench where Dionysius the Areopagite, and his fellow counsellors, sat to judge the criminals brought before them. Look towards the east and you will see a raised block of stone, and there is a similar one on the west; these are for the accuser and the defendant. Let us imagine that the calm of evening has stolen over the scene, and

that the Areopagites have assembled their court, distinguished for their rank and unblemished character. After the forms and ceremonies observed upon such an occasion have been performed, the defendant is led up those steps, and placed at the block of stone on the east, while the accuser is placed at the block on the west. By this time night has cast her sable mantle over Nature's charms, and the trial commences; for this court was not only held in the open air, but always at night, so that as judges they might not be influenced by seeing and knowing the accuser and defendant; and that no one might know the judges. Their decisions were always considered inviolable.

This hill is said to have derived its name of Areopagus, from being the place where the Amazons pitched their camp, and offered sacrifices to Mars, when they besieged Athens. Solon is said to have founded the court of the *Areopagite*. The name of Mar's Hill is said to be derived from the tradition that this demigod was the first who was tried there, for the murder of Halirrhothius.

We had now made a tolerable inspection of the remarkable places surrounding Athens, and also made ourselves somewhat acquainted with its internal arrangements, and as a favourable opportunity occurred of visiting Mount Pentelicus, we availed ourselves of it, and started early in the morning.

The road to Pentelicus is very good, until you reach the base of the mountain, which is 3,500 feet above the level of the sea, and about ten miles from Athens. The ascent of the mount was fatiguing, being over a steep slope, strewn with masses of broken marble that have fallen from the quarries above, and partially blocked up the road. As we approached the summit, we became somewhat inconvenienced by the brambles and weeds, that sprang from between the rocks, and partly concealed them, but otherwise, the ascent was not unpleasant. At last we stand upon the summit of the famous mountain from which the marbles of Athens were quarried; but the one which has been chiefly worked, is about half way up the mountain; yet there are other parts of the venerable mount that bore ample proofs of Athenian perseverance.

The view from the top, which was already occupied by a party, with their horses, was beautiful,—nay, magnificent. The line of sea-coast, forming a semicircle, where we could trace the various promontories and islands,—the hills of Greece,—the picturesque kaïques dotted over the blue water, and the plain of Marathon,

“The battle-field, where Persia’s victim horde  
First bow’d beneath the brunt of Hella’s sword,”

were all distinctly seen from the little knoll where we stood,—aye, and more that I cannot well enumerate, as their histories are too long for me to relate, and their beauties such that my pen would fail in describing them. Above all,—far,—far above our heads, were the painted clouds, “sweet beauties of the sky,” floating tranquilly along, looking so fleecy, that, as Miss Baillie has remarked, they looked  
“As though an angel, in his upward flight  
Had left his mantle floating in mid air.”

KNOWLEDGE.—We may *glean knowledge* by reading, but the chaff must be separated from the wheat by thinking. Knowledge is proud that he has learned so much—wisdom is humble that he knows no more.

BEHAVIOUR IN COMPANY.—On the subject of behaviour in company, Legh Richmond gives the following excellent advice to his daughters:

“Be cheerful, but not gigglers. Be serious, but not dull. Be communicative, but not forward. Be kind, but not servile. Beware of silly, thoughtless speeches; although you may forget them, others will not.

“Remember that God’s eye is in every place, and his ear in every company. Beware of levity and familiarity with young men; a modest reserve, without affectation, is the only safe path. Court and encourage serious conversation with those who are truly serious and conversable; and do not go into valuable company without endeavouring to improve by the intercourse permitted you.

“Nothing is more unbecoming, when one part of a company is engaged in profitable and interesting conversation, than that another part should be trifling, and talking comparative nonsense to each other.”

## PRACTICAL HINTS TO TEACHERS.

### SPELLING.

FEW branches pursued in schools are less effectually and practically taught than spelling. In this branch of education there is an important demand for a reform. The methods by which it is usually taught do not produce good practical spellers. The principle object in learning to spell should be to enable us to write words correctly; hence those methods which will most speedily and effectually attain this object are certainly the best. In treating this subject we shall first mention some of the defects in teaching spelling, hoping thereby to render the hints that may be offered more clearly understood.

Spelling words without pronouncing the syllables should not be allowed. It leads to habits of indistinct articulation. It does not teach the proper division of words into syllables; hence pupils thus taught would frequently violate the following rule for the division of words when writing:

“If there be not space enough for the whole written or printed word in one line, and a part of it is to be inserted in the next, the word should always be divided between syllables, and not elsewhere.” For instance, in writing the word *singing*, *sin* should not be placed on one line and *ging* on the next; this would cause the reader to pronounce it as if written *singing*, which would be far from meaning the utterance of musical sounds.

Another fault consists in a departure from the correct pronunciation of words by the teacher, when enunciating them for the pupils to spell. This is often done without a thought of its being a defect; indeed, some even think that the true way to pronounce words for a spelling class is to enunciate them so distinctly that every syllable is made emphatic. This supercedes all necessity of studying the lesson. In this way, too, pupils learn words with sounds so unlike those given them in reading, that they do not recognize them when correctly spoken. The true way is to pronounce the words just as a correct reader would speak them in reading, except in the inflection.

The word *often* is frequently put out by



teachers, *of-ten*, sounding the silent *t*. By this means the word pronounced is readily spelled; but what is gained by it, since that word is not heard in reading or conversation? Hence, when *of-fn*, the true pronunciation, is spoken, the pupils taught as above would seldom spell it correctly.

There is another class of words, of which *fidelity* will serve to illustrate the erroneous pronunciation. In this word the vowel *i* in the first syllable is obscure, and the word spoken as if that syllable was spelled *phy*, and had the sound of *phy* in philosophy. But the teacher pronounces it *fi-del-i-ty*, giving the vowel *i* in the first and third syllables a long sound. Here the pupil is not only learning to spell words which he will not hear in conversation or from good readers, but is also acquiring a false pronunciation. We will give but one more illustration of this kind. Words ending in *ed*, as *vowed*, *sowed*, *plowed*, *played*, should be spoken *vow'd*, *sow'd*, *plow'd*, *play'd*; but some teachers put them out to a class thus: *vow-ed*, *sow-ed*, *plow-ed*, etc. As well might he say when pronouncing the table of abbreviations, *A.M.*, before noon; *M.A.*, master of arts, thus informing the pupil what to echo back.

Another common fault in the mode of teaching spelling is this:—If a word is not correctly spelled by one pupil, the teacher puts it out to the next, and the next, and so on, until it is spelled aright by some one; then the next word is taken without requiring the pupils who have missed the word to repeat the corrected spelling. Sometimes a still worse method is practised; when a word is missed, the teacher corrects it and passes on. From this practice the pupil derives about as much intellectual good as he would of physical strength from having some one to eat for him.

Having mentioned some of the defects in teaching spelling, we will now proceed to enumerate some modes which will be likely to attain the object sought in spelling.

The BEST way which we have ever known for spelling orally, is for the teacher to pronounce a word to a class, and wait just long enough for each scholar to spell it mentally, and then

point to or name a particular scholar to spell it orally. Then another word is pronounced, and some other pupil designated to spell it, and so continued. This fixes the attention of every scholar, for no one knows who will be called upon to spell any word. If a listless pupil should be observed, he should be frequently named, till he is taught to give attention.

If such a class should consist of twenty pupils, twenty minds are at work the moment the word is uttered by the teacher. Hence it is a vast gain over the old method of spelling by rotation, by which, as soon as one pupil has spelled his word, knowing that nineteen others have to spell before his turn will come again, away goes his mind, playing ball, flying his kite, or skating, until, "in the course of human events," a word comes around once more to disturb his imaginary enjoyment, and bring home the truant, but only to escape again as soon as his word is spelled. Rotation spelling ought never to be practised, unless it be by small classes composed of the youngest children.

When teaching spelling by the method recommended above, the pupils should be requested to raise their right hands whenever an error occurs. Then one of the pupils with uplifted hand may be named to spell the word, and the scholar who missed be required to spell it correctly. This adds much animation and interest to the exercise of spelling. Another excellent method of teaching this branch, especially to the older pupils, is by the use of slates. The teacher pronounces the words slowly, giving time for all to write them simultaneously. When the lesson has thus been gone through with, the teacher takes a slate from the pupil on the right of the class handing it to one on the left, meanwhile each pupil hands his slate to the one on his right. Each scholar now examines his neighbour's work; and while the teacher reads the words, as errors are seen hands are raised and the corrections made, the pupil who made the error being required to spell the word orally, and also write it correctly on the black board. By this method a habit of writing words correctly is formed, and this is the most important object to be gained from spelling.

## BE POLITE.

THE following extract from one of Abbott's works is worthy the consideration of every one :

A clergyman once said it was beneath the dignity of a Christian to be a gentleman. His practice was consistent with his principle. Rude in feelings and uncultivated in manners, he trampled on all the civilities of life, and rendered himself almost universally obnoxious.

Though every man can not be acquainted with the rules of highly refined society, no one is excusable for being harsh, and rude, and uncivil. He who has a heart glowing with kindness and goodwill toward his fellow-men, and who is guided in the exercise of these feelings by good common sense, is the truly polite man.

Politeness does not consist in wearing a white silk glove, and in gracefully lifting your hat as you meet an acquaintance ; it does not consist in artificial smiles and flattering speech, but in sincere and honest desire to promote the happiness of those around you ; in the readiness to sacrifice your own ease and comfort to the enjoyment of others.

The poor negro women who found Mungo Park perishing under the palm trees of Africa, and who led him to their hut, and supplied him food, and lulled him to sleep with their simple songs, were genuinely polite. They addressed him in the language of kindness and sympathy, and did all in their power to revive his drooping spirits.

True politeness is a virtue of the understanding and of the heart. It is not like the whited sepulchre, or like Sodom's far-famed fruit. There are no rules for the exercise of this virtue more correct and definite than those laid down in the New Testament. There is no book of politeness comparable to the Bible. Let us examine some of these directions.

"Love your enemies, bless them that curse you, do good to them that hate you, and pray for them that despitefully use you and persecute you. See that ye love one another with a pure heart fervently. Love worketh no ill to his neighbour." See that none render evil for evil unto any man.

## THE ART OF THINKING.

BY SIDNEY SMITH.

ONE of the best modes of improving in the art of thinking, is to think over some subject before you read upon it ; and then to observe after what manner it has occurred to the mind of some great master ; you will then observe whether you have been too rash or too timid ; what you have omitted, and what you have exceeded ; and by this process you will insensibly catch a great manner of viewing a question.

It is right to study ; not only to think when any extraordinary incident provokes you to think, but from time to time to review what has passed, to dwell upon it, and to see what trains of thought voluntarily present themselves to your mind.

It is a most superior habit of some minds to refer all the particular truths which strike them, to other truths more general, so that their knowledge is beautifully methodized ; and the general truth, at any time, suggests all the particular exemplifications, or any particular exemplification at once leads to the general truth. This kind of understanding has an immense and decided superiority over those confused heads in which one fact is piled upon another, without the least attempt at classification and arrangement.

Some men always read with a pen in their hand, and commit to paper any new thought that strikes them ; others trust to memory for its re-appearance. Which of these is the best method in the conduct of the understanding, must, I should suppose, depend a great deal upon the particular understanding in question. Some men can do nothing without preparation ; others little with it ; some are fountains, some reservoirs.—*Selected.*

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CONDUCTORS OF SOUND. — Water and wood are good conductors of sound, as may be proved by the following experiments : A bell rung under the water, returns a tone as distinct as if rung in the air. Stop one ear with the finger, and press the other to the end of a long stick or piece of wood, and if a watch be held at the other end of the wood, ticking will be heard, be the wood or stick ever so long.



# POPULAR ASTRONOMY.

## LETTER XVII.

### SUPERIOR PLANETS: MARS, JUPITER, SATURN, URANUS, AND NEPTUNE.

"With what an awful world-revolving power,  
Were first the unwieldy planets launched along  
The illimitable void! There to remain,  
Amidst the flux of many thousand years,  
That oft has swept the toiling race of men,  
And all their labour'd monuments, away."—*Thomson.*

MERCURY and VENUS, as we have seen, are always observed near the sun, and from this circumstance, as well as from the changes of magnitude and form which they undergo we know that they have their orbits within that of the earth, and hence we call them *inferior* planets. On the other hand, Mars, Jupiter, Saturn, Uranus, and Neptune, exhibit such appearances, at different times, as show that they revolve around the sun at a greater distance than the earth, and hence we denominate them *superior* planets. We know that they never come between us and the sun, because they never undergo those changes which Mercury and Venus, as well as the moon, sustain, in consequence of their coming into such a position. They, however, wander to the greatest angular distance from the sun, being sometimes seen one hundred and eighty degrees from him, so as to rise when the sun sets. All these different appearances must naturally result from their orbits being exterior to that of the earth, as will be evident from the following representation. Let E, Fig. 56, be the earth, and M one of the superior planets, Mars for example, each body being seen in its path around the sun. At M, the planet would be in opposition to the sun, like the moon at the full; at Q and Q', it would be seen ninety degrees off, or in quadrature; and at M', in conjunction. We know, however, that this must be a superior and not an inferior conjunction, for the illuminated disc is still turned towards us; whereas, if it came between us and the sun, like Mercury or Venus, in its inferior conjunction, its dark side would be presented to us.

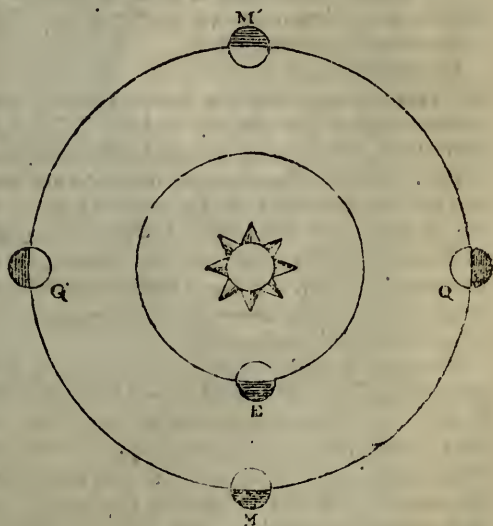


Fig. 56.

The superior planets do not exhibit to the telescope different phases; but, with a single exception, they always present the side that is turned towards the earth fully enlightened. This is owing to their great distance from the earth; for were the spectator to stand upon the sun, he would of course always have the illuminated side of each of the planets turned towards him; but so distant are all the superior planets, except Mars, that they are viewed by us very nearly in the same manner as they would be if we actually stood on the sun. Mars, however, is sufficiently near to appear somewhat gibbous when at or near one of its quadratures. Thus, when the planet is at Q, it is plain that, of the hemisphere that is turned towards the earth, a small part is unilluminated.

MARS is a small planet, his diameter being only about half that of the earth, or four thousand two hundred miles. He also, at times, comes nearer to the earth than any other planet, except Venus. His *mean* distance from the sun is one hundred and

forty two millions of miles; but his orbit is so elliptical, that his distance varies much in different parts of his revolution. Mars is always very near the ecliptic, never varying from it more than two degrees. He is distinguished from all the planets by his deep red colour, and fiery aspect; but his brightness and apparent magnitude vary much, at different times, being sometimes nearer to us than at others by the whole diameter of the earth's orbit; that is by about one hundred and ninety millions of miles. When Mars is on the same side of the sun with the earth, or at his opposition, he comes within forty-seven millions of miles of the earth, and, rising about the time the sun sets, surprises us by his magnitude and splendour; but when he passes to the other side of the sun, to his superior conjunction, he dwindles to the appearance of a small star, being then two hundred and thirty-seven millions of miles from us. Thus, let M, (Fig. 56) represent Mars in opposition, and M', in the superior conjunction, while E represents the earth. It is obvious that, in the former situation the planet must be nearer to the earth than in the latter, by the whole diameter of the earth's orbit. When viewed with a powerful telescope, the surface of Mars appears diversified with numerous varieties of light and shade. The region around the poles is marked by white spots (see Fig. 54, page 248), which vary their appearances with the changes of seasons in the planet. Hence Dr. Herschel conjectured that they were owing to ice and snow, which alternately accumulate and melt away, according as it is winter or summer, in that region. They are greatest and most conspicuous when that part of the planet has just emerged from a long winter, and they gradually waste away as they are exposed to the solar heat. Fig. 54, represents the planet as exhibited under the most favourable circumstances, to a powerful telescope, at the time when its gibbous form is strikingly obvious. It has been common to ascribe the ruddy light of Mars to an extensive and dense atmosphere, which was said to be distinctly indicated by the gradual diminution of light observed in a star, as it approaches very near to the planet in undergoing an occultation; but more recent observations afford no such evidence of an atmosphere.

By observations on the spots, we learn that Mars revolves on its axis in very nearly the same time with the earth (twenty four hours thirty-nine minutes, twenty-one seconds and three-tenths), and that the inclination of his axis to that of his orbit is also nearly the same, being thirty degrees eighteen minutes ten seconds and eight tenths. Hence the changes of day and night must be nearly the same there as here, and the seasons also very similar to ours. Since, however, the distance of Mars from the sun is one hundred and forty-two, while that of the earth is only ninety-five millions of miles, the sun will appear more than twice as small on that planet as on ours (see Fig. 51, page 247), and its light and heat will be diminished in the same proportion. Only the equatorial regions, therefore, will be suitable for the existence of animals and vegetables.

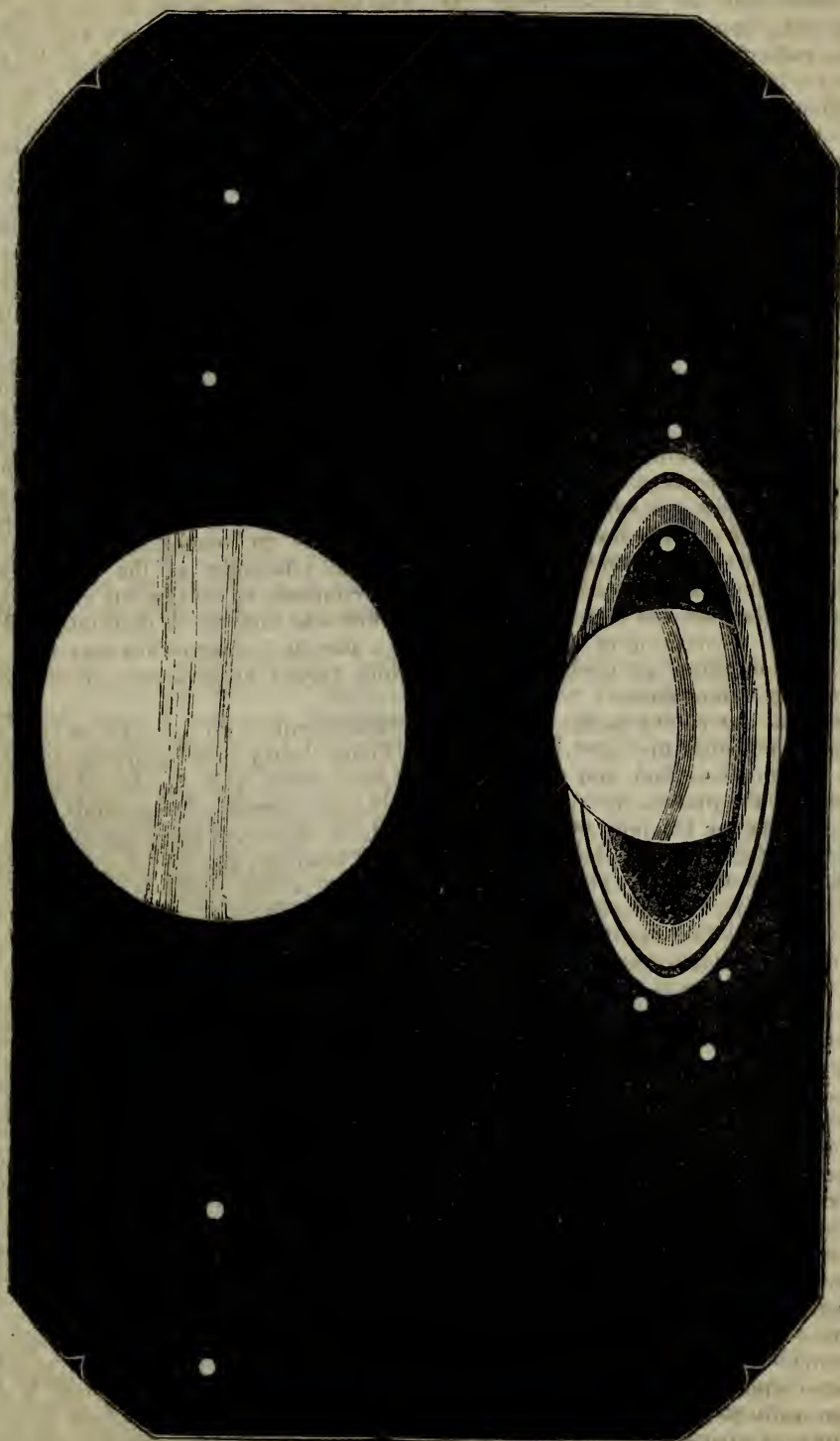
The earth will be seen from Mars as an inferior planet, always near the sun, presenting appearances similar, in many respects, to those which Venus presents to us. It will be to that planet the evening and morning star, sung by their poets (if poets they have), with a like enthusiasm. The moon will attend the earth as a little star, being never seen further from her side than about the diameter under which we view the moon. To the telescope, the earth will exhibit phases similar to those of Venus; and, finally, she will at long intervals make her transits over the solar disc. Meanwhile, Venus will stand to Mars in a relation similar to that of Mercury to us, revealing herself only when at the periods of her greatest elongation, and at all other times hiding herself within the solar blaze. Mercury will never be visible to an inhabitant of Mars.

JUPITER is distinguished from all the other planets by his great *magnitude*. His diameter is eighty-nine thousand miles, and his volume one thousand two hundred and eighty times that of the earth. His figure is strikingly spheroidal, the equatorial being more than six thousand miles longer than the polar diameter. Such a figure might naturally be expected from the rapidity of his diurnal rotation, which is accomplished in about ten hours. A place on the equator of Jupiter must turn twenty-seven



Fig. 57, 58.

JUPITER AND SATURN.



times as fast as on the terrestrial equator. The distance of Jupiter from the sun is nearly four hundred and ninety millions of miles, and his revolution around the sun occupies nearly twelve years. Everything appertaining to Jupiter is on a grand scale. A world in itself, equal in dimensions to twelve hundred and eighty of ours; the whole firmament rolling round it in the short space of ten hours, a movement so rapid that the eye could probably perceive the heavenly bodies to change their places every moment; its year dragging out a length of more than four thousand days, and more than ten thousand of its own days, while its nocturnal skies are lighted up with four brilliant moons;—these are some of the peculiarities which characterize this magnificent planet.

The view of Jupiter through a good telescope is one of the most splendid and interesting spectacles in astronomy. The disc expands into a large and bright orb, like the full moon; the spheroidal figure which theory assigns to revolving spheres, especially to those which turn with great velocity, is here palpably exhibited to the eye; and the disc, arranged in parallel stripes, are observed several dusky bands, called *belts*; and four bright satellites, always in attendance, and ever varying their positions, compose a splendid retinue. Indeed, astronomers gaze with peculiar interest on Jupiter and his moons, as affording a miniature representation of the whole solar system,—repeating, on a smaller scale, the same revolutions, and exemplifying more within the compass of our observation, the same laws as regulate the entire assemblage of sun and planets. Figure 57 (page 273), gives a correct view of Jupiter, as exhibited to a powerful telescope in a clear evening. You will remark his flattened or spheroidal figure, the belts which appear in parallel stripes across his disc, and the four satellites, that are seen like little stars in a straight line with the equator of the planet.

The *belts of Jupiter* are variable in their number and dimensions. With the smaller telescopes only one or two are seen, and those across the equatorial regions; but with more powerful instruments, the number is increased, covering a large part of the entire disc. Different opinions have been entertained by astronomers respecting the cause of these belts; but they have generally been regarded as clouds formed in the atmosphere of the planet, agitated by winds, as is indicated by their frequent changes, and made to assume the form of belts parallel to the equator, like currents that circulate around our globe. Sir John Herschel supposes that the belts are not ranges of clouds, but portions of the planet itself, brought into view by the removal of clouds and mists, that exist in the atmosphere of the planet, through which are openings made by currents circulating around Jupiter.

The *satellites of Jupiter* may be seen with a telescope of very moderate powers. Even a common spy-glass will enable us to discern them. Indeed, one or two of them have been occasionally seen with the naked eye. In the largest telescopes they severally appear as bright as Sirius. With such an instrument, the view of Jupiter, with his moons and belts, is truly a magnificent spectacle. As the orbits of the satellites do not deviate far from the plane of the ecliptic, and but little from the equator of the planet, they are usually seen in nearly a straight line with each other, extending across the central part of the disc. (See Fig. 57.)

Jupiter and his satellites exhibit in miniature all the phenomena of the solar system. The satellites perform, around their primary, revolutions very analogous to those which the planets perform around the sun, having, in like manner, motions alternately direct, stationary, and retrograde. They are all, with one exception, a little larger than the moon; and the second satellite, which is the smallest, is nearly as large as the moon, being two thousand and sixty-eight miles in diameter. They are all very small compared with the primary, the largest being only one twenty-sixth part of the primary. The outermost satellite extends to the distance from the planet of fourteen times his diameter. The whole system, therefore, occupies a region of space more than one million miles in breadth. Rapidity of motion, as well as greatness of dimensions, is characteristic of the system of Jupiter. I have already mentioned that the planet itself has a motion on its own axis much swifter than that of the earth,



and the motions of the satellites are also much more rapid than that of the moon. The innermost, which is a little further off than the moon is from the earth, goes round its primary in about a day and three quarters; and the outermost occupies less than seventeen days.

The orbits of the satellites are nearly or quite circular, and deviate but little from the plane of the planet's equator, and of course are but slightly inclined to the plane of his orbit. They are therefore in a similar situation with respect to Jupiter, as the moon would be with respect to the earth, if her orbit nearly coincided with the ecliptic, in which case she would undergo an eclipse at every opposition. The eclipses of Jupiter's satellites, in their general circumstances, are perfectly analogous to those of the moon, but in their details they differ in several particulars. Owing to the much greater distance of Jupiter from the sun, and its greater magnitude, the cone of its shadow is much longer and larger than that of the earth. On this account, as well as on account of the little inclination of their orbit to that of the primary, the three inner satellites of Jupiter pass through his shadow, and are totally eclipsed at every revolution. The fourth satellite, owing to the greater inclination of its orbit, sometimes, though rarely, escapes eclipse, and sometimes merely grazes the limits of the shadow, or suffers a partial eclipse. These eclipses, moreover, are not seen, as is the case with those of the moon, from the centre of their motion, but from a remote station, and one whose situation, with respect to the line of the shadow, is variable. This makes no difference in the *times* of the eclipses, but it makes a very great one in their visibility, and in their apparent situations with respect to the planet at the moment of their entering or quitting the shadow.

The eclipses of Jupiter's satellites present some curious phenomena, which you will easily understand by studying the following diagram. Let A, B, C, D, Fig. 59,

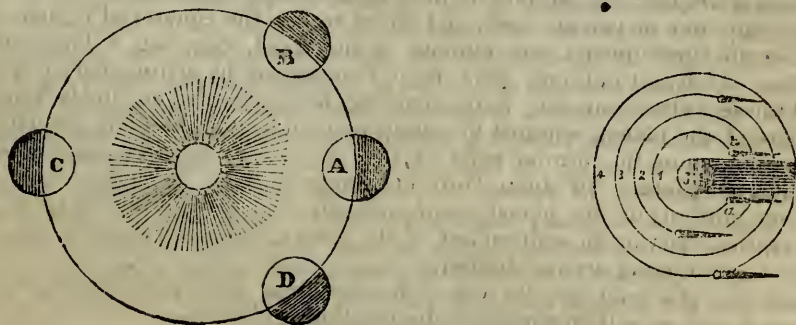


Fig. 59.

represent the earth in different parts of its orbit; J, Jupiter, in his orbit, surrounded by his four satellites, the orbits of which are marked 1, 2, 3, 4. At *a*, the first satellite enters the shadow of the planet, emerges from it at *b*, and advances to its greatest elongation at *c*. The other satellites traverse the shadow in a similar manner. The apparent place, with respect to the planet, at which these eclipses will be seen to occur, will be altered by the position the earth happens at that moment to have in its orbit; but their appearances for any given night, as exhibited at Greenwich, are calculated and accurately laid down in the Nautical Almanack.

When one of the satellites is passing between Jupiter and the sun, it casts its shadow on the primary, as the moon casts its shadow on the earth in a solar eclipse. We see with the telescope the shadow traversing the disc. Sometimes, the satellite itself is seen projected on the disc; but being illuminated as well as the primary, it is not so easily distinguished as Venus or Mercury, when seen on the sun's disc in one of their transits, since these bodies have their dark sides turned towards us; but the satellite is illuminated by the sun, as well as the primary, and therefore is not easily distinguishable from it.

The eclipses of Jupiter's satellites have been studied with great attention by astronomers, on account of their affording one of the easiest methods of determining the *longitude*. On this subject, Sir John Herschel remarks: "The discovery of Jupiter's satellites by Galileo, which was one of the first fruits of the invention of the telescope, forms one of the most memorable epochs in the history of astronomy. The first astronomical solution of the problem of 'the longitude,'—the most important problem for the interests of mankind that has ever been brought under the dominion of strict scientific principles,—dates immediately from this discovery. The final and conclusive establishment of the Copernican system of astronomy may also be considered as referable to the discovery and study of this exquisite miniature system, in which the laws of the planetary motions, as ascertained by Kepler, and especially that which connects their periods and distances, were speedily traced, and found to be satisfactorily maintained."

The entrance of one of Jupiter's satellites into the shadow of the primary, being seen like the entrance of the moon into the earth's shadow at the same moment of absolute time, at all places where the planet is visible, and being wholly independent of parallax, that is, presenting the same phenomenon to places remote from each other; being, moreover, predicted beforehand, with great accuracy, for the instant of its occurrence at Greenwich, and given in the "Nautical Almanack;" this would seem to be one of those events which are peculiarly adapted for finding the longitude. For you will recollect, that any instantaneous appearance in the heavens, visible at the same moment of absolute time at any two places, may be employed for determining the difference of longitude between those places; for the difference in their local times, as indicated by clocks or chronometers, allowing fifteen degrees for every hour, will show their difference of longitude.

With respect to the method by the eclipses of Jupiter's satellites, it must be remarked, that the extinction of light in the satellite, at its immersion, and the recovery of its light at its emersion, are not instantaneous, but gradual; for the satellite, like the moon, occupies some time in entering into the shadow, or in emerging from it, which occasions a progressive diminution or increase of light. Two observers in the same room, observing with different telescopes the same eclipse, will frequently disagree, in noting its time, to the amount of fifteen or twenty seconds. Better methods, therefore, of finding the longitude, are now employed, although the facility with which the necessary observations can be made, and the little calculation required, still render this method eligible in many cases where extreme accuracy is not important. As a telescope is essential for observing an eclipse of one of the satellites, it is obvious that this method cannot be practised at sea, since the telescope cannot be used on board ship, for want of the requisite steadiness.

The grand discovery of the *progressive motion of light* was first made by observations on the eclipses of Jupiter's satellites. In the year 1675, it was remarked by Roemer, a Danish astronomer, on comparing together observations of these eclipses during many successive years, that they take place sooner by about sixteen minutes, when the earth is on the same side of the sun with the planet, than when she is on the opposite side. The difference he ascribes to the progressive motion of light, which takes that time to pass through the diameter of the earth's orbit, making the velocity of light about one hundred and ninety-two thousand miles per second. So great a velocity startled astronomers at first, and produced some degree of distrust of this explanation of the phenomenon; but the subsequent discovery of what is called the aberration of light, led to an independent estimation of the velocity of light, with almost precisely the same result.

Few greater feats have ever been performed by the human mind, than to measure the speed of light,—a speed so great, as would carry it across the Atlantic Ocean in the sixty-fourth part of a second, and around the globe in less than the seventh part of a second! Thus has man applied his scale to the motions of an element, that literally leaps from world to world in the twinkling of an eye. This is one example of the great power which the invention of the telescope conferred on man.



Could we plant ourselves on the surface of this vast planet, we should see the same starry firmament expanding over our heads as we see now; and the same would be true if we could fly from one planetary world to another, until we made the circuit of them all; but the sun and the planetary system would present themselves to us under new and strange aspects. The sun himself would dwindle to one twenty-seventh of his present surface, (Fig. 51), and afford a degree of light and heat proportionally diminished; Mercury, Venus, and even the Earth, would all disappear, being too near the sun to be visible; Mars would be as seldom seen as Mercury is by us, and constitute the only inferior planet. On the other hand, Saturn would shine with greatly augmented size and splendour. When in opposition to the sun, (at which time it comes nearest to Jupiter), it would be a grand object, appearing larger than either Venus or Jupiter does to us. When, however, passing to the other side of the sun, through its superior conjunction, it would gradually diminish in size and brightness, and at length become much less than it ever appears to us, since it would then be four hundred millions of miles further from Jupiter, than it ever is from us.

Although Jupiter comes four hundred millions of miles nearer to Uranus than the earth does, yet it is still thirteen hundred millions of miles distant from that planet. Hence the augmentation of the magnitude and light of Uranus would be barely sufficient to render it distinguishable by the naked eye. But even further than this the observation and calculations of modern astronomers have superadded to these the planet Neptune.

Sir. J. F. W. Herschel remarks, in his "Outlines of Astronomy:"—"The discovery of Neptune is so recent, and its situation in the ecliptic at present so little favourable for seeing it with perfect distinctness, that nothing very positive can be stated as to its physical appearance. So, to observers, it has afforded strong suspicion of being surrounded with a ring very highly inclined. And from the observations of Mr. Lassell, Mr. Otto Struve, and Mr. Bird, it appears to be attended certainly by one, and very probably by two satellites,—though the existence of the second can hardly yet be considered as quite demonstrated."

From what I have already stated, it would appear that Saturn is the peculiar ornament of the firmament of Jupiter, and would present to the telescope most interesting and sublime phenomena.

## LETTER XVIII.

### SATURN.—URANUS.—ASTEROIDS.


"Into the Heaven of Heavens I have presumed,  
An earthly guest, and drawn empyreal air."—*Milton.*

SATURN, as well as Jupiter, has within itself a system on a scale of great magnificence. In size it is next to Jupiter, the largest of the planets, being seventy-nine thousand miles in diameter, or about one thousand times as large as the earth. It has likewise belts on its surface, and is attended by seven satellites. But a still more wonderful appendage is its *Ring*, a broad wheel, encompassing the planet at a great distance from it. As Saturn is nine hundred millions of miles from us, we require a more powerful telescope to see his glories, in all their magnificence, than we do to enjoy a full view of the system of Jupiter. When we are privileged with a view of Saturn, in his most favourable positions, through a telescope of the larger class, the mechanism appears more wonderful than even that of Jupiter.

Saturn's ring, when viewed with telescopes of a high power, is found to consist of two concentred rings, separated from each other by a dark space. Although this division of the rings appears to us, on account of our immense distance, as only a fine line, yet it is, in reality, an interval of not less than eighteen hundred miles. The dimensions of the whole system are, in round numbers, as follows:

	Miles.
Diameter of the planet . . . . .	79,000
From the surface of the planet to the inner ring . . . . .	20,000
Breadth of the inner ring . . . . .	17,000
Interval between the rings . . . . .	1,800
Breadth of the outer ring . . . . .	10,500
Extreme dimensions from outside to outside . . . . .	176,000

Figure 58, facing page 272, represents Saturn, as it appears to a powerful telescope, surrounded by its rings, and having its body striped with dark belts, somewhat similar, but broader and less strongly marked than those of Jupiter. In telescopes of inferior power, but still sufficient to see the ring distinctly, we should scarcely discern the belts at all. We might, however, observe the shadow cast upon the ring by the planet (as seen in the figure on the right, on the upper side); and, in favourable situations of the planet, we might discern glimpses of the shadow of the ring on the body of the planet, on the lower side beneath the ring. To see the division of the ring and the satellites requires a better telescope than is in possession of most observers. With smaller telescopes, we may discover an oval figure of peculiar appearance, which it would be difficult to interpret. Galileo, who first saw it in the year 1610, recognised this peculiarity, but did not know what it meant. Seeing something in the centre with two projecting arms, one on each side, he concluded that the planet was triple-shaped. This was, at the time, all he could learn respecting it, as the telescopes he possessed were very humble, compared with those now used by astronomers. The first constructed by him magnified but three times; his second, eight times; and his best, only thirty times,—which is no better than a common ship-glass.

It was the practice of the astronomers of those days to give the first intimation of a new discovery in a Latin verse, the letters of which were transposed. This would enable them to claim priority, in case any other person should contest the honour of the discovery, and at the same time would afford opportunity to complete their observations, before they published a full account of them. Accordingly, Galileo announced the discovery of the singular appearance of Saturn under this disguise, in a line which, when the transposed letters were restored to their proper places, signified that he had observed, “that the most distant planet is triple-formed.”\* He shortly afterwards, at the request of his patron, the Emperor Rodolph, gave the solution; and added, “I have, with great admiration, observed that Saturn is not a single star, but three together, which, as it were, touch each other; they have no relative motion, and are constituted of this form, oOo, the middle one being somewhat larger than the two lateral ones. If we examine them with an eye-glass which magnifies the surface less than one thousand times, the three stars do not appear very distinctly, but Saturn has an oblong appearance, like that of an olive, thus . Now, I have discovered a court for Jupiter (alluding to his satellites), and two servants for this old man (Saturn,) who aid his steps, and never quit his side.”

It was by this mystic light that Galileo groped his way through an organization which, under the more powerful glasses of his successors, was to expand into a mighty orb, encompassed by splendid rings of vast dimensions, the whole attended by seven bright satellites. This system was first fully developed by Huyghens, a Dutch astronomer, about forty years afterwards.† It requires a superior telescope to see it to advantage; but, when seen through such a telescope, it is one of the most charming spectacles afforded to that instrument. To give some idea of the properties of a telescope suited to such observations, I annex an extract from an account, that was published a few years since, of a telescope constructed by Mr. Tully, a distinguished English artist.

\* *Altissimum planetam tergeminum observavi. Or, as transposed, Smaismrilmle poeta leumi byne nugttaviras.*

† In imitation of Galileo, Huyghens announced his discovery in this form: a a a a a a c c c c c d e e e e e g h i i i i i l l l l m m n n n n n n n n n o o o o p p q r r s t t t t t u u u u u u: which he afterwards recomposed into this sentence: *Annulo cingitur, tenui, plano, nusquam cohærente, ad eclipticam inclinato.*



"The length of the instrument was twelve feet, but was easily adjusted, and was perfectly steady. The magnifying powers ranged from two hundred to seven hundred and eighty times; but the great excellence of the telescope consisted more in the superior distinctness and brilliancy with which objects were seen through it, than in its magnifying powers. With a power of two hundred and forty, the light of Jupiter was almost more than the eye could bear, and his satellites appeared as bright as Sirius, but with a clear and steady light; and the belts and spots on the face of the planet were most distinctly defined. With a power of nearly four hundred, Saturn appeared large and well defined, and was one of the most beautiful objects that can be conceived."

That the ring is a solid opaque substance is shown by its throwing its shadow on the body of the planet on the side nearest the sun, and on the other side receiving that of the body. The ring encompasses the equatorial regions of the planet, and the planet revolves on an axis which is perpendicular to the plane of the ring in about ten and a half hours. This is known by observing the rotation of certain dusky spots, which sometimes appear on its surface. This motion is nearly the same with the diurnal motion of Jupiter, subjecting places on the equator of the planet to a very swift revolution, and occasioning a high degree of compression at the poles, the equatorial being to the polar diameter in the high ratio of eleven to ten.

Saturn's ring in its revolution around the sun, *always remains parallel to itself*. If we hold opposite to the eye a circular ring or disc, like a piece of coin, it will appear as a complete circle only when it is at right angles to the axis of vision. When it is oblique to that axis, it will be projected into an ellipse more and more flattened, as its obliquity is increased, until, when its plane coincides with the axis of vision, it is projected into a straight line. Please to take some circle, as a flat plate, (whose rim may well represent the ring of Saturn), and hold it in these different positions before the eye. Now, place on the table a lamp to represent the sun, and holding the ring at a certain distance, inclined a little towards the lamp, carry it round the lamp, always keeping it parallel to itself. During its revolution, it will twice present its edge to the lamp at opposite points; and twice, at places ninety degrees distant from those points, it will present its broadest face towards the lamp. At intermediate points, it will exhibit an ellipse more or less open, according as it is nearer one or the other of the preceding positions. It will be seen, also, that in one half of the revolution, the lamp shines on one side of the ring, and in the other half of the revolution, on the other side.

Such would be the successive appearances of Saturn's ring to a spectator on the sun; and since the earth is, in respect to so distant a body as Saturn, very near the sun, these appearances are presented to us nearly in the same manner as though we viewed them from the sun. Accordingly, we sometimes see Saturn's ring under the form of a broad ellipse, which grows continually more and more acute, until it passes into a line, and we either lose sight of it altogether, or, by the aid of the most powerful telescopes, we see it as a fine thread of light drawn across the disc, and projecting out from it on each side. As the whole revolution occupies thirty years, and the edge is presented to the sun, twice in the revolution, this last phenomenon, namely, the disappearance of the ring, takes place every fifteen years.

You may perhaps gain a still clearer idea of the foregoing appearances from the following diagram, Fig. 60. Let A, B, C,

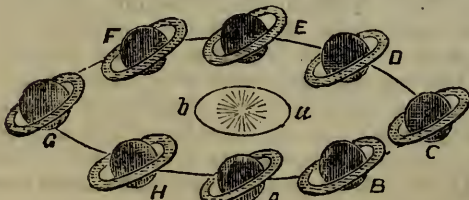


Fig. 60.

&c., represent successive positions of Saturn and his ring, in different parts of his orbit, while *a b* represents the orbit of the earth. Please to remark, that these orbits are drawn so elliptical, not to represent the eccentricity of either the earth's or Saturn's orbit, but merely as the projection of circles seen very obliquely. Also, imagine one half of the body of the planet and of the ring to be above the plane of the paper, and the other half below it. Were the

ring to be above the plane of the paper, and the other half below it. Were the

ring, when at C and G, perpendicular to C G, it would be seen by a spectator situated at *a* or *b* as a perfect circle; but being inclined to the line of vision twenty-eight degrees four minutes, it is projected into an ellipse. This ellipse contracts in breadth as the ring passes towards its nodes at A and E, where it dwindles into a straight line. From E to G the ring opens again, becomes broadest at G, and again contracts, till it becomes a straight line at A, and from this point expands till it recovers its original breadth at C. These successive appearances are all exhibited to a telescope of moderate powers.

The ring is extremely *thin*, since the smallest satellite, when projected on it, more than covers it. The thickness is estimated at only one hundred miles. Saturn's ring shines wholly by *reflected light* derived from the sun. This is evident from the fact that that side only which is turned towards the sun is enlightened; and it is remarkable, that the illumination of the ring is greater than that of the planet itself, but the outer ring is less bright than the inner. Although we view Saturn's ring nearly as though we saw it from the sun, yet the plane of the ring produced may pass between the earth and the sun; in which case also the ring becomes invisible, the illuminated side being wholly turned from us. Thus, when the ring is approaching its node at E, a spectator at *a* would have the dark side of the ring presented to him. The ring was invisible in 1833, and also in 1847. The northern side of the ring will be in sight until 1855, when the southern side will come into view. It appears, therefore, that there are three causes for the disappearance of Saturn's ring: first, when the edge of the ring is presented to the sun; secondly, when the edge is presented to the earth; and thirdly, when the unilluminated side is towards the earth.

Saturn's ring *revolves* in its own plane in about ten and a half hours. La Place inferred this from the doctrine of universal gravitation. He proved that such a rotation was necessary; otherwise, the matter of which the ring is composed would be precipitated upon its primary. He showed that, in order to sustain itself, its period of rotation must be equal to the time of revolution of a satellite, circulating around Saturn at a distance from it equal to that of the middle of the ring, which period would be about ten and a half hours. By means of the spots in the ring, Dr. Herschel followed the ring in its rotation, and actually found its period to be the same as assigned by La Place,—a coincidence which beautifully exemplifies the harmony of truth.

Although the rings have very nearly the same centre with the planet itself, yet recent measurements of extreme delicacy have demonstrated, that the coincidence is not mathematically exact, but that the centre of gravity of the rings describes around that of the body a very minute orbit. "This fact," says Sir J. Herschel, "unimportant as it may seem, is of the utmost consequence to the stability of the system of rings. Supposing them mathematically perfect in their circular form, and exactly concentric with the planet, it is demonstrable that they would form (in spite of their centrifugal force) a system in a state of unstable equilibrium, which the slightest external power would subvert, not by causing a rupture in the substance of the rings, but by precipitating them unbroken upon the surface of the planet." The ring may be supposed of an unequal breadth in its different parts, and as consisting of irregular solids, whose common centre of gravity does not coincide with the centre of the figure. Were it not for this distribution of matter, its equilibrium would be destroyed by the slightest force, such as the attraction of a satellite, and the ring would finally precipitate itself upon the planet. Sir J. Herschel further observes, that, "as the smallest difference of velocity between the planet and its rings must infallibly precipitate the rings upon the planet, never more to separate, it follows, either that their motions in their common orbit round the sun must have been adjusted to each other by an external power, with the minutest precision, or that the rings must have been formed about the planet while subject to their common orbital motion, and under the full and free influence of all the acting forces.

"The rings of Saturn must present a magnificent spectacle from those regions of the planet which lie on their enlightened sides, appearing as vast arches spanning the sky



from horizon to horizon, and holding an invariable situation among the stars. On the other hand, in the region beneath the dark side, a solar eclipse of fifteen years in duration, under their shadow, must afford, to our ideas, an inhospitable abode to animated beings, but ill compensated by the full light of its satellites. But we shall do wrong to judge of the fitness or unfitness of their condition, from what we see around us, when, perhaps, the very combinations which convey to our minds only images of horror, may be in reality theatres of the most striking and glorious displays of beneficent contrivance."

Saturn is attended by *seven satellites*. Although they are bodies of considerable size, their great distance prevents their being visible to any telescope but such as afford a strong light and high magnifying powers. The outermost satellite is distant from the planet more than thirty times the planet's diameter, and is by far the largest of the whole. It exhibits, like the satellites of Jupiter, periodic variations of light, which prove its revolution on its axis in the time of a sidereal revolution about Saturn, as is the case with our moon, while performing its circuit about the earth. The next satellite in order proceeding inwards, is tolerably conspicuous; the three next are very minute, and require powerful telescopes to see them; while the two interior satellites, which just skirt the edge of the ring, and move exactly in its plane, have never been discovered but with the most powerful telescopes which human art has yet constructed, and then only under peculiar circumstances. At the time of the disappearance of the rings (to ordinary telescopes), they were seen by Sir William Herschel, with his great telescope, projected along the edge of the ring, and threading like beads, the thin fibre of light to which the ring is then reduced. Owing to the obliquity of the ring, and of the orbits of the satellites to that of their primary, there are no eclipses of the satellites, the two interior ones excepted, until near the time when the ring is seen edgewise.

"The firmament of Saturn will unquestionably present to view a more magnificent and diversified scene of celestial phenomena than that of any other planet in our system. It is placed nearly in the middle of that space which intervenes between the sun and the orbit of the remotest planet. Including its rings and satellites, it may be considered as the largest body or system of bodies within the limits of the solar system! and it excels them all in the sublime and diversified apparatus with which it is accompanied. In these respects, Saturn may justly be considered as the sovereign among the planetary hosts. The prominent parts of its celestial scenery may be considered as belonging to its own system of rings and satellites, and the views which will occasionally be opened of the firmament of the fixed stars; for few of the other planets will make their appearance in its sky. Jupiter will appear alternately as a morning and an evening star, with about the same degree of brilliancy it exhibits to us; but it will seldom be conspicuous, except near the period of its greatest elongation; and it will never appear to remove from the sun further than thirty-seven degrees, and consequently will not appear so conspicuous, nor for such a length of time, as Venus does to us. Uranus is the only other planet which will be seen from Saturn, and it will there be distinctly perceptible, like a star of the third magnitude, when near the time of its opposition to the sun. But near the time of its conjunction it will be completely invisible, being then eighteen hundred millions of miles more distant than at the opposition, and eight hundred millions of miles more distant from Saturn than it ever is from the earth at any period." \*

URANUS.—Uranus is the remotest planet belonging to our system, and is rarely visible, except to the telescope. Although his diameter is more than four times that of the earth, being thirty-five thousand one hundred and twelve miles, yet his distance from the sun is likewise nineteen times as great as the earth's distance, or about eighteen hundred millions of miles. His revolution around the sun occupies nearly eighty-four years, so that his position in the heavens, for several years in succession, is nearly stationary. His path lies very nearly in the ecliptic, being inclined to it less

\* Dick's "Celestial Scenery."

than one degree. The sun himself, when seen from Uranus, dwindles almost to a star, subtending, as it does, an angle of only one degree and forty minutes; so that the surface of the sun would appear there four hundred times less than it does to us. This planet was discovered by Sir William Herschel, on the 13th of March, 1781. His attention was attracted to it by the largeness of its disc in the telescope; and finding that it shifted its place among the stars, he at first took it for a comet, but soon perceived that its orbit was not eccentric like the orbits of comets, but nearly circular, like those of the planets. It was then recognised as a new member of the planetary system, a conclusion which has been justified by all succeeding observations. It was named by the discoverer the *George Star* (Georgium Sidus), after his munificent patron George III.; in the United States, and in some other countries, it was called *Herschel*; but the name *Uranus*, from a Greek word (*Οὐρανός*, *Ouranos*), signifying the oldest of the gods, has finally prevailed. So distant is Uranus from the sun, that light itself, which moves nearly twelve millions of miles every minute, would require more than two hours and a half to pass to it from the sun.

And now, having contemplated all the planets separately, just cast your eyes on the diagram on page 247, Fig. 51, and you will see a comparative view of the various magnitudes of the sun, as seen from each of the planets.

Uranus is attended by *six satellites*. So minute objects are they, that they can be seen only by powerful telescopes. Indeed, the existence of more than two is still considered as somewhat doubtful. These two, however, offer remarkable and indeed quite unexpected and unexampled peculiarities. Contrary to the unbroken analogy of the whole planetary system, the *planes of their orbits are nearly perpendicular to the ecliptic*, and in these orbits their motions are retrograde; that is, instead of advancing from west to east around their primary, as is the case with all the other planets and satellites, they move in the opposite direction. With this exception, all the motions of the planets whether around their own axes, or around the sun, are from west to east. The sun himself turns on his axis from west to east; all the primary planets revolve around the sun from west to east; their revolutions on their own axes are also in the same direction; all the secondaries, with the single exception above mentioned, move about their primaries from west to east; and, finally, such of the secondaries as have been discovered to have a diurnal revolution, follow the same course. Such uniformity among so many motions could have resulted only from forces impressed upon them by the same Omnipotent Hand; and few things in the creation more distinctly proclaim that God made the world.

Retiring now to this furthest verge of the solar system, let us for a moment glance at the aspect of the firmament by night. Notwithstanding we have taken a flight of eighteen hundred millions of miles, the same starry canopy bends over our heads; Sirius still shines with exactly the same splendour as here; Orion, the Scorpion, the Great and the Little Bear, all occupy the same stations; and the Galaxy spans the sky with the same soft and mysterious light. The planets, however, with the exception of Saturn, are all lost to the view, being too near the sun ever to be seen; and Saturn himself is visible only at distant intervals, at periods of fifteen years, when at its greatest elongations from the sun, and is then too near the sun to permit a clear view of his rings, much less of the satellites that unite with the rings to compose his gorgeous retinue. Comets, moving slowly as they do when so distant from the sun, will linger much longer in the firmament of Uranus than in ours.

(To be continued.)



## THE MIRROR OF NATURE.

*(Continued from page 256.)*

WHAT the eye is to the individual body of an animal or man, that the air is, and the water, for all living beings; in much simpler ways it is true. When the air is thick and foggy, then a great part of the light of the sun and stars is lost to us. The cloud, which envelopes us at mid-day, when high up on the rocky heights of the Alps, or on the fields of perpetual winter, or on the glaciers, instantly renders it impossible for us to proceed any further on the dangerous way; and the smoke which sometimes rises at the great eruptions of the Iceland volcanoes, and even the coal smoke from the chimneys of that great European capital, London, makes it so dark in valley, and plain, and street, that people have to kindle lights at mid-day. What would become of us, and what would become of most animals and plants, if our planet were not surrounded by this transparent atmosphere, which lets the rays of light and heat down to the lowest plains? What would become of the inhabitants of the ocean, if the sunlight did not descend to them, or shine dimly at least down into the great deep?

It appears, it is true, very dark down in the depths. In the combustion of bodies (of which we will speak further on), the air may certainly become a sun on a small scale, a fountain of light and heat, but ordinarily the water and the air resemble only an eye, which must first, by an external light, be prepared and strengthened for vision. Below, in the caverns of the earth, as Baker learned, when he, with his family, strayed into the great Cave at Levington, no ray of sunlight penetrates, although the stream of air which filled the place was warmed at one end by the daylight. The greater portion of the rock of which the outer rind of our planet is formed, and the earthy soil which covers the mountains, is, to the light, at least to the light perceptible to our eyes, wholly impenetrable. For the few transparent or translucent stones and salts therein lie for the most part concealed in such dark masses, that no ray of light can reach them. The great eye of the earth, the atmosphere, together with the water, possesses the

power of receiving and diffusing the sunlight, chiefly for the benefit of living beings, offering the surface of that power everywhere where there are beings who are in need of light.

But within the opaque walls of our houses there are living beings who need the light of day, and who find joy in the sunshine—we and our children. We have built ourselves these houses, that they may protect us from heat, rain, wind and frost. If here and there, besides the door, we make openings for the daylight, then with the light, comes the heat or the wind, rain and frost, and like the marmot or the dormouse, when they prepare themselves for their winter rest, we are compelled to close all these openings and remain in darkness. We must think of giving to the dark rooms of our dwellings eyes, which shall receive and diffuse the light within. A body, penetrable to the light, but impenetrable to the air and the wet, and in some degree to the heat, is best fitted to serve our rooms and chambers in the place of eyes.

Animal horn, split into thin leaves, allows the daylight to shine through; but the light shining through horn is only a weak twilight, and the horn is so much affected by the light and the weather, that it loses its translucency. Nevertheless, in old times there were horn windows in the huts in which men lived, as well as lanterns of horn. The inhabitants of Siberia have an easier way of providing their dwellings with eyes. In some mountains of that region there are large masses of a kind of stone, called mica, which is easily split into plates and thin leaves, and which, especially when it is of a light colour, is translucent in a pretty high degree. But out of Siberia, there are very few places in which mica can be found of a sufficient size to admit of plates being cut from it several inches square; if we had no other substances to give light to our dwellings, ninety-nine houses out of a hundred would have to remain without eyes. The evil would be yet greater, if, instead of mica and horn, we had to depend upon the translucent shell of the windowpane muscle, (*Placuna placenta*), which is found particularly in the Chinese Sea. This material is so rare that scarcely the thousandth, or rather the hundred

thousandth part of human dwellings could be furnished with eyes.

The Phœnicians, it is said, first succeeded in discovering a way of meeting this urgent and universal want. The invention was so nearly made by the Egyptians, that they may have known and, although only partially, practised the art of making glass, even before the Phœnicians. For the specimens of glass, found with their mummies, which have been buried three, and perhaps four thousand years, show that the Egyptians were originally masters of that art. It required only the fine sand of the valley of the Nile together with the mineral alkali or soda, which exists in their lakes, and which, in many places on the northern coasts of Africa, as at Tripoli, can be scraped from the rocks (the Trona-Soda), to be subjected to a strong heat, and a combination is formed in which the silica takes in opposition to the alkali the place of the acid; this combination was and is glass. And not merely soda, but vegetable alkalis also, such as potash, and even common wood ashes mixed with silica, and subjected to vitrification in fire, give a more or less transparent glass. For in the mass from which our dark-coloured bottles are here and there made, there is no pure alkali, but it consists chiefly (apart from the common salt or lime mixed sometimes with the fluid at pleasure) of one hundred and sixty parts of wood ashes, one hundred parts of quartz-sand, and fifty parts of basalt. When in these combinations of silica and the alkali, the latter predominates, when, for instance, five parts of the caustic alkali are united with one part of silica, there arises the silicious fluid, which is easily mixed with water, (soluble glass). In the preparation of pure glass, when pure alkali is used, six parts of silica and one part of the alkali are employed. To the fusion which gives us the so-called mirror-glass, is generally added saltpetre, and a small quantity of manganese ore, and in the manufacture of flint glass, even a slight addition of white arsenic and a large portion of red oxide of lead, in order to render the mass colourless and clear, are found advantageous.

Before all other substances, besides the silica, which is everywhere found in great

abundance, it is potashes, and especially soda, which renders it possible for human art to introduce light into the darkness of our dwellings, and which is to be used for the universal and daily want of windowpanes. This application of the old invention the Romans understood and practised, as has been discovered through the single windowpanes found in the houses of the city of Pompeii, which, in the year A. D. 79, was buried at an eruption of Vesuvius under a shower of ashes. Glass, formed into square plates, the lighter the better, allows the light to pass through it, but presents a screen against the heat, of a stove for instance, in like manner with opaque bodies that are not metallic. On this account glass possesses all those qualities which a medium ought to have, which is calculated to guard against the weather and to communicate light.

In its use for windows, whereby the largest portion of human dwellings were rendered truly habitable, the invention of glass brought a great advantage to the nations of the earth. This use of it was in its consequences vastly more important than the other uses made of the art, such as the making of coloured glass in imitation of precious stones, or the manufacture of various kinds of vessels which are recommended by the ease with which they can be kept clean, as well as their transparency and form. Yet another use of the art of glass-making was reserved to a later age, which not only gave to our dwellings their light, but to man himself new and higher powers of vision.

The first step in this domain of invention was that by which men learned by artificial means to restore to old age the power of youthful vision.

It is related that a poor sailor-boy, whose father was a maker of spectacles, on a certain time, when the ship in which he was employed as cook, was about to sail for the west coast of Africa, received from his father a quantity of spectacles with an address in Lisbon, where articles of that sort were to be sold. The ship was prevented by bad weather from running into Lisbon, as had been the captain's first intention. Favoured afterwards by the wind, its course was turned to the south, and the gold coast was safely reached, the proposed limit of the voyage.



The bartering with European wares for gold, ivory, and other valuables of the torrid zone, commenced and had a favourable result. Not only the captain and pilot, but even several of the sailors returned daily to the ship with rich profits, exchanging their European wares for things of a much higher value. It occurred to the boy to make a trial in trade with the spectacles from his father's workshop; he went on land, and had the good fortune to gain admission to the king with his wares, which the negroes had never before seen. This favour he owed to an old man of the court, who was in the daily service of the king. In order to make the old courtier understand the use of the article which the youth proposed to sell, he set a pair of spectacles on his nose, and the old man was at once enabled to see near objects with the distinctness of his younger years. But even the king himself, who was advanced in years, together with many of his old friends, stood in need of such a restoration of his diminished eyesight, and was not a little rejoiced when the art of the whites offered him a means thereto. The black potentate tried all the spectacles on his flat nose; the choice was difficult; he resolved to keep all these wonderful eyes for himself and his friends. Through a misunderstanding which the pilot, who acted as interpreter, fell into accidentally, or purposely, from good will to the young man, the demand made for the spectacles by their modest possessor, was understood by the negro king to be almost a hundred fold greater than it actually was. Nevertheless, this prince, so opulent in gold-dust and ivory, hesitated not a moment to pay the price. Perhaps he expected that with the artificial restoration of the noblest organ, the vigour of youth might be restored also to his whole body. Of all the ship's company, the sailor boy had made the most profitable business, when he returned, according to his rank, quite a rich man, to the house of his father, the old spectacles-grinder.

More intelligible still than the joy of the old negro prince at such a renovation of his eyesight was the rapture of the old brahmin when the excellent spectacles, which an Englishman had presented to him, at once enabled him to read the

sacred books of his law, which he had not been able to do for many years. It is precisely in this business of reading that the old perceive most painfully the loss of sight for near objects, their power of seeing at a distance remaining the same, and when the aged man, who is unable to distinguish any writing with his naked eye, puts on his spectacles, he can read at once. However, one must not carry his expectations of the spectacle-maker's art quite so far as that peasant who went to a fair to purchase what was needed at home. He stood at the stall of a dealer in spectacles, and saw how several people made their purchases. A book, with fine print was handed to them, they put on one pair or another of spectacles and then looked attentively on the book. "Can you read well with those?" the dealer asked, and when they answered in the affirmative, the bargain was soon struck. The peasant then conceived a desire to purchase a pair. He approached the counter, took the book, put on a pair of spectacles and looked into the book, but put off one pair after another with a shake of his head. The trader, wishing to assist him in his choice, offered him various pairs, which he thought would suit: the remark of the peasant remained always the same: "I cannot read with them." At last a person, who had come to buy, said to the peasant, "Friend! tell me pray, do you know how to read?" "You fool!" replied the peasant, "if I could read, I would not be buying spectacles."

Familiar as we are with spectacles, they were not invented immediately upon the invention of transparent glass. A writer of old Rome, Seneca, has indeed remarked that through a glass-ball, filled with water, the letters of a book were seen in a magnified form; and an Arabian writer of the eleventh century, named Alhazen states, that by means of a glass-ball, all kinds of small objects may be seen enlarged. There was a long interval, however, between the knowledge of this fact, and the representation of such flattened, round (convex) ground glasses, as render the same service in a much better and more convenient way. The use of such glasses, raised on both sides, for eye-glasses or spectacles, was taught to modern nations by the Italians. The first inventor of spectacles

was a nobleman of Tuscany, named in the inscription on his gravestone in the Church of Maria Maggiore at Florence, Salvino degli Armati. He died in 1317. According to others, to the Dominican monk, Alexander de Spina, who died in 1313, belongs a part of the glory of the invention, or at least of its more common application. For, when Spina had seen and admired a pair of spectacles and had in vain inquired of the man, in whose possession they were, how they were made, he betook himself to work, and without further delay, fell upon the plan of giving a convex surface to a round disk of glass, by placing it in a saucer-like concave cup, and by rubbing or grinding it down for a long time with a fine powder of rotten stone or emery. Two glasses of this description were at first placed in a frame, at a distance from each other corresponding to the distance between the eyes, and fastened to a cap which was drawn over the brows when the spectacles were to be used, and afterwards pushed back. Soon the bows or arms of the spectacles were added, made of horn, and the spectacles were bent in front so as to rest upon the nose. It will here be in place to speak of the contrivance and effect of magnifying glasses, and of the reason of their effect in general.

Besides the property of magnifying objects, we all know that (bean or) lens-shaped glasses have another property, by virtue of which they serve as burning-glasses to set on fire combustible bodies; the property of directing all the rays of the sun, which fall upon the different parts of the glass lens, to one point, the burning point (or focus.) The greater the surface of a burning-glass, and the nearer, by virtue of the convexity of its surface, the focus lies to the glass, so much the greater is its power. This can yet be seen in the large burning-glasses which Tschirnhausen, a German nobleman of Upper Lusatia, caused to be made by means of a mill made for the purpose. Two of these gigantic glasses, made about the year 1686, and weighing more than a hundred weight, are yet in Paris; their diameter is thirty-three inches; the focal distance of one is seven feet, of the other twelve feet. Wood thoroughly wet is set on fire, and even pine-wood lying in water is instantly charred, metals melt, and water

boils, when placed in the focus of such a glass. Tschirnhausen was at a great expense in the preparation of these burning-glasses, which, however, render no particular service to science; he would have done vastly more good by glasses of a cheaper kind. When, for instance, two concave glasses (somewhat similar to large watch-crystals) are joined together at their rims, and the space between them is filled with turpentine, we have an instrument, in whose focus the effect of the sun's rays here concentrated, is immensely increased above that of a glass lens. Two Frenchmen of science, Brisson and Lavoisier, prepared such a burning-glass in the year 1774, filled with turpentine-oil, which was four feet in diameter and eight inches thick in the middle. Connected with a common glass lens, which was placed between this great instrument and its focus, and which collected the sun's rays that passed through the same to a nearer and smaller focus, this contrivance had such uncommon power that the hardest metals could be fused. Copper coins, which in the focus of Tschirnhausen's lens took three minutes to become fluid, melted here in half a minute; iron laid on a coal almost instantly. We see something of the same kind on a small scale when the sun shines through a round bottle filled with water, and the focus falls on a combustible body; conflagrations have been occasioned in this way.

The ancient Greeks, who were very well acquainted with the property of setting inflammable substances on fire possessed by crystal balls, such as are found in many rivers (as the so-called Rhineflints in the Rhine), wondered at the relation between the crystal and the fire which it occasioned; the crystal remaining cold, while it set other bodies out of itself in a flame. The reason of this lies tolerably near at hand, and becomes evident when we consider a so-called concave mirror. If the form of a shallow broad basin is given, for instance, to a mirror of metal or glass, and the same is placed with its centre in a straight line with the sun, all the rays of the sun are reflected back in a direction, the reverse of that which water poured into a tunnel takes, towards a common point which lies in a straight line with the centre of the mirror. Every single point of the burn-



ing mirror is thus heated no more by the ray which strikes it than any other piece of metal or looking-glass; but the power of the light reflected by them all to a common point, is so great that the hardest metals may be fused, and the diamond evaporated.

In the case of the transparent glass, however, to which the forms of magnifying and burning glasses are given, there comes, before all things, to the aid of human art, an essential universal property of transparent bodies, the *refracting power* of the same.

Every child may remark that when a stick is partly inserted into the clear water of a lake or river in a slanting direction, and when it is looked at sideways, it appears as if it were broken at the surface of the water, as if it consisted of two sticks, one of which extends straight to the water, and the other, somewhat sideways from the former, begins at the surface of the water, and takes a direction not in a straight line with the part above the water. When one lays any heavy, shining body in the bottom of a vessel, and takes a position at such a distance from the vessel that the body, deposited in it, is hidden by the rim of the vessel and cannot be seen—then if the vessel is filled with water, the shining body will again become visible, as if it had moved from the place where it lay towards the side of the vessel farthest from the eye; and yet this is only apparent, it remains unmoved in its place. An illusion similar to this was experienced by the Dutch voyager, Berenz, and his companions in suffering, when, surviving the fearful hardships of a long polar winter night, they saw morning dawn again. The sun appeared over the ice and snow-fields of the horizon nineteen days earlier than it was expected by exact calculation; but this visibility of the sun's disc, which was still actually below the horizon, was occasioned by the refracting power of the thicker strata of the atmosphere.

When one takes a stick, as mentioned above, and places it as standing upright in the water, and then looks down in a straight line from the upper end to the lower, no breaking of the line is apparent. The stick continues to our eye under the water in the same direction, which it has above in the air. When now a ray of light, proceeding from a luminous or illu-

minated body, passes in an oblique direction under a greater or less angle from one transparent medium into another, it will to our eyes appear, if the second medium is denser than the first, to be broken in a direction which lies towards the line perpendicular to the surface of the second medium at the point where the ray passes; as it is with the example which we have mentioned, where a shining body, lying at the side of a vessel, after water is poured in, is at once seen nearer to the centre of the vessel. The reverse takes place, when we employ a vessel, the upper half of which is filled with water, while the lower part, separated from the upper by a transparent partition, contains air. A shining body, lying in the lower part, will appear to us, when we stand at a proper distance from the imaginary perpendicular line drawn from above downwards through the centre of the vessel, to be at a greater distance from that line, and moved toward the side of the vessel nearest to us.

When the ray of a body illuminated by the sun, falls from the vacuum in an air-pump into the common air of our room, it suffers a refraction of the last mentioned kind; on the contrary, if it passes from water into a solid transparent body, it suffers the opposite refraction. The density of bodies is not the only circumstance which causes the higher or lower degree of the refracting power of the light; the quality of the transparent substance exerts an essential influence. Combustible bodies, which on being ignited become a source of light, exercise upon the light, which passes through them, the strongest influence. When the great Sir Isaac Newton inferred, from the strong refraction of the light in the transparent diamond, that this stone of stones, this hardest body of the earth, is of a combustible nature like oil and wax, and published his conjecture of the combustibility of the diamond in his "Optics," many of his scientific contemporaries may have laughed at the idea; and yet, his supposition was shortly afterwards confirmed, when Kosmus III., at Florence, in the year 1694, consumed for the first time a diamond in the focus of one of Tschirnhausen's large burning glasses. As among all solid bodies, the diamond, phos-

phorus, sulphur, and the combinations of carbonic acid, and of sulphur with some of the metals when they attain to transparency, manifest the strongest refracting power, so, among the fluids, the easily inflammable essential oils, and spirits of wine, and among the gaseous bodies, hydrogen gas or inflammable air, possess the same property.

The same thing, which occurs, in the appearance of a stick when held in an oblique direction in water, takes place in the case of every ray of light, which passes from the air into a denser transparent body, whose surface is, not flat, but as in a glass ball or lens of glass, bent and rounded. The rays of light fall towards the thinner rim of such a lens, more and more obliquely upon the surface, and, according to the law which regulates the passage of light from a rarer, transparent medium into a denser, become broken or bent, towards the line passing through the centre or axis of the lens. When we look through such a lens, not merely do the unchanged, straight rays, which an illuminated body sends through the middle of the lens, fall on the eye, but those rays also which strike upon the curved parts of the surface; and the body appears to us magnified in a high ratio.

In the way thus generally indicated, do those artificial eyes operate, which man has obtained the use of since the employment of glass in the preparation of spectacles and burning-glasses.

*(To be continued.)*

**GREAT CHEESE FACTORY.** — George Hezlep's great cheese factory in Ohio, America, converts the milk of about 2,500 cows, belonging to farmers in the neighbourhood, into the best cheese, by labour-saving machinery. The curd is made, sacked, and marked by the farmer, and sent to the factory by a wagon, which daily goes the rounds. Eight teams are thus employed. The curd is then weighed, sliced rapidly in a machine; then passed through the double curd-cooking apparatus; then through a machine which cuts it fine to powder, and salts it while passing through. It is then pressed, sacked, and again pressed. A machine sacks 240 cheeses per hour. The factory makes 300 cheeses daily, weighing about 500 pounds.

## THEORY OF THUNDERSTORMS.

THAT artificial storm with lightning and thunder which was caused, to the amazement of all beholders, by a certain Anthemius, a skilful mechanician and architect, in the times of the emperor Justinian, in the sixth century, may have resembled, perhaps, those artificial storms produced in our theatres by a peculiar machinery, and the sudden ignition of various combustibles. This kind of imitation has as little real resemblance to a natural storm as a wax figure to the living human shape of which it is a copy. Somewhat otherwise is it on the other hand with those storm-like phenomena which are presented by the electrical apparatus. When the model of a house, according to Lilliputian measure, formed of paper or wood, is set on fire by the electric spark; and when the wires of a charged electric jar are brought in contact with another similar model, provided with a lightning-rod, through which the electric fluid passes without setting the house on fire, then we are dealing, although upon a very small scale, with the same natural power, which, in the upper regions of the atmosphere, generates lightning and thunder.

The same electric condition which we produce by friction, or, by merely laying metallic plates one upon another, and again separating them, takes place continually between the atmosphere and the surface of the earth. It goes on increasing to a certain height, so that the electricity of the upper stratum stands for the most part in stronger opposition to the electricity of the earth's surface, than that of the lower strata. In clear weather the electricity of the atmosphere is generally positive, that of the earth negative. In a cloudy sky the electricity of the air is sometimes positive and sometimes negative, about as often one as the other. The air is not, as a whole, electrically opposed to the earth; but even single strata and masses of vapour may be more or less opposed to one another.

All these electrical relations between the earth and the air, and between the different masses of vapour and air in the higher regions of the atmosphere, are usually regulated by imperceptible discharges, and a tendency to equilibrium;



the ascending vapours, the descending water of the atmosphere, the low floating mists and clouds, give out their electricity to the material substances which are in an opposite electric condition; and, as the explosion of gunpowder ceases so soon as its combustible ingredients have combined with oxygen, so every trace of electrical action vanishes when one of the two opposite movements has, like a ball falling into the hand, come to a standstill. Yet is this gentle flowing of the electric fluid from above downwards, and from the earth into the atmosphere, perceptible to the eye in those phenomena which are sometimes seen at night on the pinnacles of steeples, on the masts of ships, and other perpendicular objects; and even, under certain circumstances, on the tips of the fingers held up in the air,—a phenomenon which the people of ancient times attributed to the propitious vicinity of the Dioscuri, Castor, and Pollux, but which our ancestors named St. Elmus fire.

Vegetation, also, has a very considerable influence on the development of electricity, and it is reckoned that the electricity which is called forth by a field of 25 square fathoms would suffice to load a battery, heavy enough to kill an ox or a horse. The evaporation of the waters of the sea also has a great influence in increasing atmospheric electricity; for not pure, distilled water, but water with an admixture of foreign, and especially salty particles, is very favourable, while evaporating to electrical activity. The electricity of the air, however, is equalised by every shower, by every breath, by the shadow of every cloud, producing coolness as it passes. The electrical condition of the air around us may be changed more than twenty times in a day, and may be indicated as a positive and then as a negative excess by our instruments, when it is imperceptible to our senses.

In general it is remarked, that when the north or east winds prevail, the electricity of the air is more positive; during the prevalence of south and west winds, more negative. It is found, however, in the same latitudes to be much stronger in still weather than in windy, by day than by night, when the deposition of watery vapour causes the equalization of the opposite states. Manifold as are the ways

by which this equalization is effected, they do not always suffice to prevent that accumulation of electricity in the clouds, which occasions the phenomena of thunderstorms.

When, in the warm days of summer, the vegetable world stands clothed in its full green, the rising vapour becomes more abundant, and fills the upper regions of the air with its positive electricity; when, at the same time, the clouds float at such a height that the electrical equilibrium between them and the earth's surface is with difficulty maintained, then those conditions gradually take place, under which storms are most easily generated. The dry strata of the air act as insulators, like the glass between the tinfoil coatings of a Leyden-jar, and so the electric charge is increased.

In the winter months, from November to February, thunderstorms are rare. The low hanging clouds, the moist air, the diminished heat of the earth, the greatly lessened evaporation of water, permit no considerable degree of electrical action to be produced. In October and March only a few thunderstorms occur. In April they are, one year reckoned with another, five times more frequent than in March; in May they are twice as frequent as in April; in June more than three times; in July almost four times; in August more than thrice,—and then their frequency diminishes, and they are about as numerous in September as in April. In cold countries, for the same reasons, thunderstorms are rarer than in hot countries; yet even under the 75th degree of north latitude, in the climate of New Siberia and Spitzbergen, violent thunderstorms have been known.

Thunder-clouds are generally distinguished by their dark colour, and round, distinctly defined outline, circumstances which go to show their high degree of condensation. The height at which they stand, reaches, in hot countries and in the neighbourhood of mountains, sometimes to 9,000 feet, in the plains of central Europe, to from 3 to 7,000 feet; in the cold climate of Tobolsk, the height of the clouds is often only 600 or 700 feet. Before a thunderstorm breaks forth, the air is, for the most part, very sultry, its electrical condition suffers sudden and

great changes. The discharge begins, so soon as the moisture of the air has formed a communication from one side of this great battery to another; the electric stroke, whose spark here takes the form of lightning, and whose sound becomes thunder, darts most often only from one cloud, from one overcharged stratum of air to another. As, however, the electric condition of the higher regions of the atmosphere calls forth in the lower regions, and in all objects on the earth's surface, the opposite electrical state in the same strength, the electric discharge takes often a direction downwards and towards the earth. The lightning strikes especially such bodies as are good conductors of electricity, as metals for instance; next to the metals, however, are living organised bodies, plants, and animals. For this reason, it is dangerous to seek protection in a thunderstorm under high trees. In regard to the exposure of the vegetable world in a thunderstorm—it is said that the lightning never strikes the birch-tree, and the same was anciently maintained of the laurel; hence a crown of laurel was placed on the head as a protection against lightning in a thunderstorm. Also the house-leek (*sempervivum tectorum*) which is planted on the roofs of houses, is held by the countrypeople to be a good defence against lightning.

It depends chiefly upon the force of the electricity of the ground, whether and with what violence the discharge of the cloud will take its direction towards the earth; whether the lightning will strike. The warmth of the earth's surface and the capacity of the intervening strata of the atmosphere to conduct the lightning, are of great influence. On which account in some regions of the torrid zones, thunderstorms are so dangerous that, according to the account of Azara, in a single storm in the year 1793, in the space of scarcely an hour, the lightning struck thirty-seven times, and nineteen persons were killed in the city of Buenos Ayres in South America.

When the lightning strikes the earth, there is not unfrequently a *returning* stroke observed, not only during great volcanic eruptions, but, on a small scale, in the action of our electrical apparatus. In this case, the lightning passes from the

earth to the air, or spreads itself far and wide from a point on the earth. Such earth strokes sometimes hurl stones and earth into the air; and in some cases, have produced effects as destructive as those strokes that proceed from the air to the earth. The latter, when they fall upon a sandy soil, cause here and there a melting of the quartz-sand, producing the so-called fulgurites.

The lightning does not always ignite the combustibles which it strikes. In such cases, it appears to act like the electric spark of our powerful artificial batteries, which heats metallic wire red-hot, and even melts it, but passes through gunpowder without exploding it (perhaps, because the power of the carbon to conduct it does not give it sufficient time). By using a wet string as a more imperfect conductor, by which the electric spark is communicated to the powder, the powder immediately explodes. A ship, called the *New York*, was struck by lightning twice in one thunder gust. It spread through the whole vessel without setting it on fire, and without injuring any one. Indeed one of the passengers, who had suffered for a long time from lameness, all at once regained the use of his limbs, in consequence either of the fright or of the electric influence. All the knives and forks on board became magnetic through the effect of the lightning. It was observed of the magnetic needles, which were all in one room, that some of them became more powerfully magnetic, while others had become weaker. In other instances, the electric influence confines itself to the metals in the vicinity of the place struck by lightning. Thus a house has been struck, without being set on fire, or without injury to its inmates, while the metallic works of the clocks in the house, and even the wire on the thatched roof, was melted. In another case, the gold upon a gilt watch-hand was melted and transferred to the lead of which the case was made, and which thus became gilt.

It is true it is the conducting power of the moist air, by means of which the lightning strikes the earth, for through a stratum of the air of one or more fathoms, thick it would hardly be able to pass, yet rain contributes at the same time its part to diffuse the discharge of electric clouds,



or every drop of a heavy shower brings with it a considerable portion of the electricity of the air to the ground, and there an equilibrium is established between it and the opposite electrical state of the earth. Hence the violence of a thunder-storm is gradually lessened, when the rain accompanying it is long continued.

Generally those clouds that discharge hail, float the lowest of all storm-clouds. Hail is not an infrequent attendant of a thunder-storm. Hail-clouds, which are distinguished by the irregular, jagged look of their outlines, and by their whiter colour, when they lie so low, (for there are hail-clouds that float very high), appear to form the lowest stratum or bed of a mass of clouds in which is generated, on a giant scale, a series of mutually opposed electrical conductors, similar, as we shall see hereafter, to the plates of a voltaic pile. It has often happened that wanderers on mountain heights have found themselves in the midst of hail-clouds, the hail being in the process of formation, and still floating in the air. A close observer (Lecocq), remarked, on such an occasion, that the hail-stones had a rotatory motion. The cold, occasioned by such masses of ice, in a tolerably high temperature of the surrounding air, can hardly be caused, according to the opinion of some scientific men, by the evaporation of the water alone, so that other co-operating forces of polaric action must be supposed. Hail-stones, for the most part, appear to be formed of different layers, one over another, having in the centre a snow-like nucleus, or some foreign solid substance, borne by the wind from the soil or the mountain crags. Their size is from several lines to several inches. In the hail-storm at Maestricht, in 1827, hail-stones were picked up six inches in diameter. At Clermont, in 1835, ellipsoidal hail-stones of the size of a hen's egg were found, and when a quantity of these stones adhered together in falling, great masses of ice were formed. As the greyish-white hail-clouds, below and between the dark black storm-clouds, form only thin strata and strips, so also their desolating effect is often confined to a space of country, not over some thousands, and even some hundred feet in breadth, although it may extend in length one or

several miles. There are, however, hail storms that greatly exceed these limits; of this kind was that fearful hail shower that in 1788 fell upon France, extending over two separate strips of land, the length of which amounted to more than a hundred miles, the breadth of one strip being from two to three miles, that of the other more than a mile. The country between and outside, escaped. Hail rarely falls in the night, still more rarely in winter. Even the countries within the tropics are almost never visited with hail, and the cold regions near the pole very seldom.

Like rain, hail also brings the electric fluid to the ground and helps to equalize it. The electric action, however, is not seldom neutralized in a still more imperceptible manner by a gentle transmission of the opposite kinds or states of electricity from one cloud to another, or from the air to those points on the earth's surface, which readily attract and transmit the fluid. From such a quiet and less violent passing of electricity from cloud to cloud, the so-called *heat-lightning* may arise, although, in most cases, this is nothing but the reflection of a flash of lightning striking at a great distance below our horizon. The possibility of effecting a gradual, or even a harmless discharge of atmospheric electricity, has been rendered easy to human science, since a closer knowledge has been obtained of electrical phenomena.

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CARRIAGE-SPEED MEASURES. — Mr. Carey's Measuring-machine is intended to record the number of revolutions made by the wheel of a carriage. The apparatus is very small, and is buckled by straps to one of the spokes of the wheel near the nave; it of course follows the curved course of the part of the wheel to which it is attached; and once in each revolution it causes a wheel to be advanced one tooth; so that the number of teeth advanced determines the number of revolutions made by the wheel. It was a contrivance something like this in principle, though differing in details, which James Watt devised for registering the number of strokes of a steam-engine. There is no limit to the ingenuity and usefulness of art in the present day.

## DISCOVERY OF GUTTA-PERCHA.

It was in the year 1842 that Dr. Montgomerie, an assistant-surgeon to the Residency at Singapore, accidentally lighted upon a knowledge of this remarkable gum. He was one day watching a *parang*, or native wood-cutter, at his labour; and was struck with the appearance of the hatchet or chopper employed by him. The handle seemed to be formed of some material very different from those usually employed. "I questioned the workman," says Dr. Montgomerie, "in whose possession I saw it, and heard that the material of which it was made could be moulded into any form by dipping it into boiling water till it was heated through, when it became plastic as clay, regaining when cold its original hardness and rigidity." An intelligent physician was not likely to lose sight of such a remarkable substance. He speedily ascertained that gutta-percha, like caoutchouc, exudes from between the bark and the wood of certain forest-trees. He procured specimens in various stages of preparation, and sent them to the Society of Arts in London. Seldom has the Society's gold medal been more fittingly awarded, than for the valuable knowledge thus communicated to the manufacturers of our country.

It is observable, however, that this substance may be said to have had two European discoverers, independent of each other; for the tree, and the gum which exudes from it, were discovered or observed by Mr. Thomas Lobb. This gentleman visited the islands of the Indian seas in 1842-3 on a botanical mission, as agent to Messrs. Veitch, the scientific and energetic florists of Exeter; and it was during his rambles that he became acquainted with the gutta-percha tree.

In proportion as the value of this substance has become known, so has a desire extended to ascertain the range of its growth in the East. It is now known that the gutta-percha tree abounds in that extreme south-eastern point of Asia which obtains the name of the Malay Peninsula; in the neighbouring island of Singapore; in the important Bornean island which Rajah Brooke has been the means of making so familiarly known to us; and in

various islands which constitute the Eastern Archipelago. There seems very little cause to apprehend any failure in quantity; for even if the present supply from the neighbourhood of Singapore should be exhausted, the capabilities of more distant islands are quite beyond present calculation.

It appears that *percha* (of which the pronunciation is *pertsha*, not *perka* or *persha*) is the Malayan name for the tree which produces the gum; while *gutta* is a general name for any gum which exudes from a tree. The tree belongs, of course, to the group in which botanists place *sapotaceous* or gum-exuding genera. The wood of the tree, being soft and spongy, is not applied to many useful purposes. The fruit yields a thick oil, which is used by the natives with their food; and either from this or from some other parts of the tree an ardent spirit is capable of being distilled. But it is the sap which forms the most valuable product of the tree. It circulates in small vessels which run up between the bark and the wood.

Thrifty methods are teachable to rude islanders, as to more civilised men, when the advantages have been once made apparent. The natives around Singapore, when they first found a market for the solidified gum, proceeded ruthlessly to work; they killed the bird which laid the golden eggs, by cutting down the trees in order to obtain the gum. But they have now been taught better; it is shown to them how, by tapping or cutting notches in the branches at certain intervals of time, the sap may be made to flow, without endangering the life of the tree. Experiments are now being made to determine whether the gutta-percha tree can be planted so as to maintain a continuous and inexhaustible store of gum or sap: should these attempts succeed, the supply would equal any imaginable demand.

The gutta-percha is sold at Singapore by weight, according to the apparent quality of each lump; but, when the consignment reaches England, it is not unfrequently found that a large stone or a piece of heavy wood is imbedded in the heart of it to increase the weight. It would entail a serious loss of time to cut open each lump at the time of purchase; so that at present Oriental honesty is



rather an important element in the commercial value of this article. There is, too, a great amount of difference in the quantity of bark, leaves, and dirt, which become accidentally mixed up with the gum.

### IRON—BAR AND ROD.

It was towards the close of the last century that the capital improvement was introduced of bringing malleable iron into the forms of bars and rods, by passing it between grooved rollers instead of simply hammering it on the anvil; but it is in the present century that the invention has worked out its striking results. The inventor, however—like too many other inventors—lacked a sufficient return for his ingenuity: he spent his fortune in the enterprise, and died poor. Mr. Cort introduced and patented this method in 1784; and his son petitioned Parliament in 1812 to make some return for the vast national benefit which had by that time accrued from the invention; but it does not appear that any fruits resulted from the application.

Another improvement—and one that certainly must take rank among the Curiosities of the Iron manufacture—was the introduction of iron-slitting mills into this country. Until the invention (just noticed) of rollers for making bars and rods, all bars above three-quarters of an inch square were made by the tedious process of hammering at the anvil; while sizes below that limit were produced by slitting, which superseded a much less efficient process. Coleridge, in his 'Letters, Conversations, and Recollections,' gives the following narrative:—"The most extraordinary and best attested instance of enthusiasm existing in conjunction with perseverance, is related of the founder of the Foley family. This man, who was a fiddler, living near Stourbridge, was often witness of the immense labour and loss of time caused by dividing the rods of iron necessary in the process of making nails. The discovery of the process called slitting, in works called slitting-mills, was first made in Sweden; and the consequences of this advance in art were most disastrous to the manufacturers of iron about Stourbridge. Foley,

the fiddler, was shortly missed from his accustomed round, and was not again seen for many years. He had mentally resolved to ascertain by what means the process of slitting of bars of iron was accomplished; and without communicating his intention to a single human being, he proceeded to Hull, and thence, without funds, worked his passage to the Swedish iron port. Arrived in Sweden, he begged and fiddled his way to the iron-foundries, where, after a long time, he became a universal favourite with the workmen; and, from the apparent entire absence of intelligence, or anything like ultimate object, he was received into the works, to every part of which he had access. He took the advantage thus offered, and having stored his memory with observations on all the combinations, he disappeared from amongst his kind friends as he had appeared, no one knew whence or whither. On his return to England he communicated his voyage and its results to Mr. Knight and another person in the neighbourhood, with whom he was associated, and by whom the necessary buildings were erected and machinery provided. When at length everything was prepared, it was found the machinery would not act; at all events it did not answer the sole end of its erection—it would not slit the bar of iron. Foley disappeared again, and it was concluded that shame and mortification at his failure had driven him away for ever. Not so: again, though somewhat more speedily, he found his way to the Swedish iron-works, where he was received most joyfully; and, to make more of their fiddler, he was lodged in the slitting-mill itself. Here was the very end and aim of his life attained beyond his utmost hope. He examined the works, and very soon discovered the cause of his failure. He now made drawings or rude tracings; and having abided an ample time to verify his observations and to impress them clearly and vividly on his mind, he made his way to the port, and once more returned to England. This time he was completely successful, and by the results of his experience enriched himself and greatly benefited his countrymen. This" (adds Coleridge) "I hold to be the most extraordinary instance of credible devotion in modern times."





### MONSOONS.

THESE are periodical winds which blow over the Indian Ocean, between Africa and Hindustan for nearly six months from the north-east, and during an equal period from the south-west. The region of the monsoons lies a little to the north of the northern border of the trade-winds, and they blow with the greatest force and with most regularity between the eastern coast of Africa and Hindustan. When the sun is in the southern hemisphere a north-east wind, and when it is in the northern hemisphere a south-west wind blows over this sea. The north-east monsoon blows from November to March. It extends one or two degrees south of the equator. It becomes regular near the coasts of Africa sooner than in the middle of the sea, and near the equator sooner than in the vicinity of the coasts of Arabia. This wind brings rain on

the eastern coast of Africa. The south-west monsoon does not extend south of the equator, but usually begins a short distance north of it. It blows from the latter end of April to the middle of October. Along the coast of Africa, it appears at the end of March; but along the coast of Malabar, not before the middle of April: it ceases, however, sooner in the former than in the latter region. The rainy season on the west coast of Hindustan commences with the first approach of the south-west monsoon. The monsoons prevail also on the seas between Australia and China.

The effect of the struggle which precedes the change in the direction of the wind in this part of the world is thus described in "Forbes's Oriental Memoirs." The author was encamped with the English troops:



"The shades of evening approached as we reached the ground, and just as the encampment was completed, the atmosphere grew suddenly dark, the heat became oppressive, and an unusual stillness presaged the immediate setting-in of the monsoon. The whole appearance of external nature resembled those solemn preludes to earthquakes and hurricanes in the West Indies, from which the East in general is providentially free. We were allowed very little time for conjecture. In a few minutes the heavy clouds burst over us. I had witnessed seventeen monsoons in India, but this surpassed them all in its awful appearance and dreadful effects. Encamped in a low situation on the borders of a lake formed to collect the surrounding water, we found ourselves in a few hours in a liquid plain; tents giving way in a loose soil—the tents fell down—and left the whole army exposed to the contending elements. It requires a lively imagination to conceive the situation of a hundred thousand human beings of every description, with more than two hundred thousand elephants, camels, horses, and oxen, suddenly overwhelmed by this dreadful storm in a strange country, without any knowledge of high or low ground, the whole being covered by an immense lake, and surrounded by thick darkness, which rendered it impossible for us to distinguish a single object except such as the vivid glare of the lightning occasionally displayed in horrible forms. No language can adequately describe the wreck of a large encampment thus instantaneously destroyed, and covered with water, amid the cries of old men and helpless women, terrified by the piercing shrieks of their expiring children, unable to afford them relief. During this dreadful night more than two hundred persons and three thousand cattle perished miserably, and the morning dawn exhibited a shocking spectacle!"

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THEORIES are the mighty soap-bubbles with which the grown-up children of science amuse themselves; while the honest vulgar stand gazing in stupid admiration, and dignify these learned vagaries with the name of wisdom.—*Washington Irving.*

## REMARKS ON DRAWING.

BY W. C. GOLDTHWAIT.

For apparatus, we need nothing more than a drawing pencil, or even a common pencil and a page of white paper. As we progress, we shall need pencils of different shades, and our taste will lead us to select drawing-paper and perhaps Bristol-board; but the simple materials named above are sufficient for the beginner. To make the first attempt some simple building of regular shape may well be selected. Any *barn* or *warehouse* will be willing to sit for its picture. Having determined to "Daguerreotype" such an object, we should take our position at some distance, and so as to see two of its sides plainly. The pupil should learn to *stand* erect, and hold the book or portfolio in his hand, while he pursues these labours. This position is far more healthful than sitting, and soon all unsteadiness will give place to perfect ease and firmness. In many cases we *must* stand while sketching; hence we should early acquire the habit.

Having taken our position then, as suggested, we shall find that *one corner* of the building is nearest us. The line representing that will be perpendicular. Let a perpendicular line, representing that, be drawn on the contemplated sketch. It may be of any length; but the pupil will remember that all the other lines must be *in proportion*; hence it should not be too long. Sketches are more graceful and easily finished, if small. Young pupils and copyists usually design *large* pictures, as if, like masons, they finished their work by the yard. This perpendicular line is drawn according to the principle—

I. *All perpendicular lines in Nature, are, in sketching, to be drawn perpendicularly.*

The pupil will now ascertain what part of the building is on a level with his eye. A little observation, in the most careless, will determine this with sufficient accuracy. If the eaves appear to be on a level with the eye, let a line be drawn *horizontally* from the upper end of the perpendicular, to the right or left, as the side down which the eaves' drip appears. right or left of the corner first drawn. These lines will, of course, be at right

angles to each other. The last line is thus drawn according to the principle—

II. *All horizontal lines in Nature, on a level with the eye, are, in sketching, drawn horizontally.*

At the end of the second line thus drawn, will be another perpendicular. This is to be drawn according to Rule I. Its length also may be determined by the method just described. It will invariably be shorter than the first perpendicular, because it is more remote, in compliance with Rule VI.

It should be remarked here, that the line representing the eaves is drawn horizontally, because it is on a level with the eye, Rule II. Had our position been differently chosen, had we taken our position in front of the building, so that the line of the eaves did not recede from us, that is, so that each of its ends was equally distant from the eye, it would still have been drawn horizontally, even if it were *not* on a level with the eye; according to this principle—

III. *All horizontal lines in Nature, whether above or below the eye, that do not recede from us, are, in sketching, to be drawn horizontally.*

It may now be desirable to finish the side of the building we have commenced. The base-line alone remains. This is below the eye, and, as we took our first position, it recedes from us. It must therefore ascend as it recedes, according to the principle—

IV. *All lines in Nature, that are below the eye, and that recede from us, will in sketching, ascend as they recede.*

The rapidity of the ascent will depend upon two conditions; one is the distance below the eye. If a line lies far below us, it will, on that account, ascend rapidly. Again; if a line recede rapidly, it will, for that reason, ascend rapidly.

Much is left to the eye here, but fortunately not all. We have a very convenient way of ascertaining the position of a line. Hold the pencil as described before, under Rule II., so that it shall coincide with any line to be experimented upon, and the position of the pencil will indicate the direction of the line. If it is level, or ascends toward the right or left, it will not be difficult to draw a required line on the sketch, with a similar inclination. Or, if this is not plain enough, we can, keeping

the pencil fixed, bring the sketch in an upright position with the other hand, directly behind the pencil, till the pencil itself actually rests on the place of the desired line. The true position of the line can no longer be doubtful. Experiments of this kind may often be necessary for the pupil, and even the experienced artist will not fail to find times, when some expedient is needful, or his perspective will not bear the critic's eye.

The outlines of the first side are now, as we will suppose, complete. But from our first position two sides are visible. If so, a line representing the third corner is now to be drawn. This is a perpendicular, Rule I. The only point of difficulty is its distance from the first perpendicular. This may be ascertained by the eye, or by the method under Rule II. The base-line of this side is to be drawn by Rule IV. This line will ascend as it recedes; as did the other base, but in an opposite direction, because it recedes in an opposite direction.

If this side or end is surmounted by a gable, this may now be drawn. The first step may be to ascertain the location of the apex. This must of course be over the middle. That found, we have only to ascertain the height. This may be done by trial; and, having located it, draw lines from it to each of the eaves, and the outline is complete. Possibly the roof may appear too steep or flat; if so the remedy is easy. That is, erase the last lines, and try again till this portion of the building appears correct. The roof will now demand attention. Probably, the ridge will first be drawn. Starting from the apex of the gable, already located, it will descend to the other, the more remote end, according to this principle—

V. *All horizontal lines in Nature, that are above the level of the eye, and that recede from us, will, in sketching, descend as they recede.*

It only remains to draw a line bounding the remote end of the roof. If our position is remote from the building, this will be sufficiently accurate if it is drawn parallel to the first end; or its position may be determined by the method mentioned under Rule IV.

It is obvious, if these suggestions are followed, that the remote end of the roof,



as of each of the sides, will be somewhat smaller than the end nearest us. This will be according to the principle—

VI. *All objects in Nature, that recede from us, will, in sketching, diminish in size as they recede.*

This will confirm the rules IV. and V., and by it the accuracy of our perspective may be tested. The pupil will need to heed this particularly, or he will often be misled. Frequent measuring will guard from many gross mistakes.

The outlines of our building are now complete, and, if correctly drawn, will appear upon the paper as if a piece of glass, covered with transparent resin or varnish, had been held up directly before our eyes, and the outlines sketched with a pointed instrument upon it. Taken in this way, the perspective would be literally correct, and our work, so far as possible, should be as perfectly so. At least it should be *natural*; there should be no *distortions*. Without this, no sketch can be tolerable, whatever beauty of colouring it may possess. Our mode of sketching this plain building will suggest the mode we would pursue in all cases. We might have chosen a very different position; though this would have changed the direction of the lines; still the same great principles would apply equally well. They are invariable. Or, having chosen this position, we might have commenced our sketch at any other part; it would have made no difference with the result.

But when we have completed the grand outlines, there still remains much to be done. If it is a dwelling of man, and not of beast, windows will need to be inserted, doors must be opened, and whatever *characterizes* the building is to be represented on paper. In drawing the tops and sides of all these, so far as straight lines are employed, the same rules are to be observed as in the main outlines. Not even the bar of a windowsash should be drawn by the pupil without thinking of the *principle* that gives direction to it. In the *size* of these particulars, the pupil will generally err by making them too large. He should often inquire what proportion they bear to the whole side on which they are. Frequent measuring will be of great service.

With regard to the *location* of such details as windows and doors and the like,

the eye must govern; but it is by no means difficult to determine this with sufficient accuracy. Such questions as these will often occur: How far is such a window or door from the side of a building, or from the top? How does the space between the windows compare with the size of the windows themselves? Attention is always to be paid to *foreshortening*. A window seen on a receding side will retain its proportionate length, but may be very much diminished in width. We are to remember to draw things as they *appear*, and not as they are. Observance of these things, and a determination to make the sketch a representation of the object itself, in every important particular, will conquer a host of difficulties.

We would suggest that all these lines should be drawn very *faintly* at first, till it appears that they are correct; then they can, by a few passages of the pencil, be made plainer. Otherwise, having been drawn with a heavy hand, they cannot be erased, if wrong, without greatly marring the surface of the paper. The beginner should also bear in mind that, though straight lines are desirable, *ruling* is inadmissible. It gives a stiff, wiry appearance to the outlines, which is very offensive to the eye of the artist. The fine wavering appearance, that will characterize all lines drawn by the unguided hand, is far more pleasant.

The building now exists in outline. To the eye of the artist it is almost complete. He sees it all embodied before him. The finishing may be supplied after the lapse of years. Sketches from a journey are frequently brought home in this form, and finished at leisure. Still, much remains to be done. The outlines are to be filled up—the skeleton is to be clothed with flesh. This leads us to speak of shading, or aerial perspective.

Some of the more obvious principles of shading may be stated. Scarcely any part of a building or sketch is to be left entirely white. In a sunny day, the light comes mostly from one particular part of the heavens. Though the radiating point may change every moment, yet at any given period there is one principal source of light. So, in putting on the “lights and shadows,” we first inquire from what source the light proceeds. We may be

governed by the position of the sun at that moment, or we may *conceive* the light to come from any side; but, having once determined that point, it remains fixed for the picture.

Of course, all the shadows fall in one direction—away from the light.

Generally, the sides of buildings and objects exposed to the light will be light, while others will be dark. But this rule admits of many modifications. The bright side will not all be equally light. That part which adjoins a dark side will be usually left much lighter than any other part. So of a dark side, the darkest part will be adjoining a sunny side. In this way we secure strong contrasts. And in this matter the pupil should observe that we sometimes take great liberties with Nature. She, the mistress of elegant shading, has an almost infinite variety of colours.

But our pencil-point will only afford us the shades of *one* colour; with these we must portray sunlight and shade, sky and trees. If Nature would have the eye distinguish between one field and its neighbour, she can fill one with yellow grain, and paint the approaching harvest in the other with some shade of green; while we can only leave one light, and throw a mass of shade into the other. The same remark applies to different buildings and parts of the same building. But in some way distinctness must be secured in all objects that are near us. More remote objects undergo a process called “degradation,” and lose somewhat of their distinctness.

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But other and very important parts remain to be spoken of. Almost every building that gratifies a painter's eye is shown on a “setting” of trees; hence the *foliage* must not be overlooked. This is, in most cases, the easiest to perform, and at the same time the most difficult to describe. No part seems so unattainable at first; no part is so easy, when we *know how*. The pencil of the artist does not move with great regularity here. We aim to copy the general outline of trees. Each tree has its peculiar profile and expression. This is learned by observation. The poplar points to heaven in a very different way from the maple. The elm

extends its arms in a summer wind in a very different way from the hemlock and pine. The weeping willow droops like inconsolable grief; the hardy oak stands up in stiff independence, like a “sultan's standard in a host;” while the locust fairly *titters* in the joy of receiving a lover's visit from the breeze. The *expression* we design to copy; but “every leaf in those countless forests” must not expect a profile. We dash them off by the thousand. When we would make a mass of foliage, we assemble, without any premeditation or order, a congress of *z's*, and *s's*, and *w's*, in close juxtaposition. We need but few marks; but these decided, spirited. Pupils work too much upon the foliage; they fairly *close up* the space allotted to it with a multiplicity of fine dashes, till the group of leaves look more like a mess of “cut feed,” or the bottom of a mince-bowl, than living laughing trees,

“Telling their tales, through the long summer day,

To the cool west wind.”

The *ground* will also ask some little care. All level surfaces are depicted by horizontal lines, more or less dark and thick, as the case may demand. A certain roughness and unsteadiness is desirable in these lines. If the surface is covered with grass and herbs, a few random cuts, after the ground has been shaded, to represent leaves and herbs, will be far better than an attempt to make every spear of green leave its autograph.

If the *aréa* is *water*, the same work will do as foreground, only the vegetation will be out of place, and these lines should be somewhat sharper and more regular and steady. This will give great transparency to the surface.

The sky also must not be omitted. The same parallel lines, spoken of in the description of ground and water, will do here, if the pupil can think of nothing better. Let him remember that the sky always appears, by way of contrast, to grow brighter as it approaches the horizon. But ours is not a world of perpetual clear skies, hence some attempts must be made to represent those “wandering cisterns,” the clouds, that go floating over us. This is not difficult. Any rude engraving may well be consulted. That



will convey the instruction as well as a professor. If the pupil would grace his sketch with the most lively of all objects, those snow-white drifts and vapour, that rise of a summer afternoon, and stand in the firmament like "bulwarks of some viewless land," and always lift the thought, in the words of our dearly-beloved Watts,

"Up to the fields where angels lie,  
And living waters gently roll,"

the task is more difficult, and should not be rashly attempted by a beginner.

We have thus finished the suggestions we designed. They refer simply to what is called "still life," in painting. Moving objects, animals, and, above all, the human face divine, belong to a higher department, and require more skill and practice. But this done, that will be comparatively easy; or without attempting that, this branch of the art is sufficient to beautify many of the seasons of life.

We have said little of drawing from copies. We do not believe it necessary as an introduction to this delightful art. Nature is the best copy. With the suggestions here made, and a close observation of the principles of perspective, one, even with ordinary talent, can hardly fail of success, especially if he engages the aid of a teacher who knows how to limmer from Nature himself, and believes he can teach others to do the same. But if any one who reads these lines is sincerely anxious to learn, let him not hesitate because he cannot enjoy the assistance of the artist. "I will try," has done wonders; and surely the prospect is flattering enough to entice us on. It is true that the difficulty is greater for some than for others; but even if we are in the worst case, and have not what is denominated an "eye" for seizing the proportions, we need it in almost all kinds of business, and nothing will confer upon us that possession so surely as an attention to this pursuit. But in most cases the difficulty is only imaginary.

Fellow-teachers, this subject is especially appropriate for us. The influence of such an acquirement upon ourselves could not but be desirable. It would refine the taste; it would tend to prolong the freshness of youth; it would enable us to see a thousand beauties unseen before; it

would frequently afford a salutary relief from the vexations of our business, and add new pleasure to our vacation excursions. And how rich the benefit, if we can convey some knowledge of this delightful art to the little company of disciples that crowd around us for instruction. It will contribute to make us longer remembered as persons of taste and successful teachers. It will diffuse an atmosphere of refinement over the school-room; it will tend, as all our labours should, to diffuse an air of courtesy and refinement around the future life of those we teach; it will kindle up new lights in the "haunts and homes" of the future fathers and mothers, and *teachers*; it will make the current of life go more softly, if we can teach even a small portion of our pupils "to guide the pencil and turn the tuneful page."

These acquisitions are in themselves desirable—but we look mostly to the effect upon the whole character. Attention to the fine arts, a taste for good literature, existing along with sterling qualities of character and more solid possessions, refines, chastens all the rest. It is like one sister in a family of brethren; it is like one species of fragrant flower in a field of grass; and, amid the trials of life, it seems like the sweet voice of a girl, singing in a quiet room in a subdued tone, while the storm rages without. Future existence has storm and battle enough in reserve for all our pupils. How much they will need the amenities of life, the influence of the delicate arts, some knowledge of science and literary pursuits to keep them from low and vulgar associations, and refresh the mind when it is worn with the contentions of business! And, oh! how much they will need simple, fervent piety! Some may think there is no connection between these things of which mention has been made, and this latter possession. It is true, the connection is remote enough. But happily Taste and Morals are not quite disassociated in our world, as bad as it is. And we believe that, as a class, the educated, the refined, are likely not only to be better citizens and more agreeable companions here; but (is it too much to say?) more likely to plant their feet at last on those happy, peaceful shores, where the Good and the Beautiful will stay in our presence for ever. Hence, as a preparation for

future life, and as a matter that will be likely to have a favourable bearing upon our preparation for the world to come, we look upon a good taste and its exhibitions—upon Drawing and Music, and correct literature—as, in the words of the poet, with some modification,

“The first note of organ, heard within  
Cathedral aisle, ere yet its symphonies begin.”

### ELECTRIC LIGHT.

IN 1846 the world was first startled with the novelty of the Electric Light. Scientific men had long been familiar with the intensity of the light caused by electric action, but it was Messrs. Greener and Staite, we believe, who first devised a form of apparatus for public lighting by such agency. Their patent of the year above named described an arrangement whereby small lumps of pure carbon, enclosed in air-tight vessels, were rendered luminous by currents of galvanic electricity. Little was done, in the first year, beyond the promulgation of the method; but in 1847 the evening gazers in London were astonished by the occasional flashes of intense light thrown out upon them from elevated spots; and one of the inventors estimated the merits of the system so highly, as to state the comparative cost of lighting to be in the ratio of one to six, or eight, as compared with gas.

So far as it can be described in a few words, the following will convey an idea of the mode of producing the light. In the first place there were two small cylinders or bits of pure carbon, with their points placed toward each other some small fraction of an inch apart. As they were subjected to a slow combustion, the points of these cylinders receded further and further apart; but this recession was corrected by a train of wheel-work which advanced them in an equal degree in the opposite direction, so that the carbon points were maintained equidistant. A galvanic battery was provided, and the two carbon cylinders lay in the direction of the circuit through the wires, so that the galvanic circuit could not be completed unless the fluid could traverse the small distance from one piece of carbon to the other. It is one among the many properties of electricity, that when the

subtle agent has thus to leap over the interval, as it were, from one point to another, it generates an intense heat at that point; and the points being, in the apparatus in question, formed of a slowly combustible body, like carbon, the heat generates, or is at least accompanied by, an intense light. The task which most called forth the ingenuity of the inventors, was to keep the carbon points at such a distance as to render the light continuous instead of intermitting; for an intermitting or flickering light would be nearly valueless in ordinary cases.

Numerous practical difficulties presented themselves in this novel experiment, and they have not yet been surmounted so satisfactorily as to lead to the practical application of the light.

### IRON LIGHTHOUSES.

IRON lighthouses take rank among the novelties to which this invaluable metal is now applied. Most readers have some amount of acquaintance with the grand structures at Eddystone, Bell Rock, and Skerryvore; and will readily understand how valuable it would be if such works—or rather works to answer the same object—could be carried to the destined spot piecemeal, but nearly in a finished state, and require only to be put together. Such is one of the many favourable features of the modern iron lighthouses. We believe it was Captain Sir Samuel Brown, the engineer of the Brighton Chain Pier, who first made a formal proposition to this effect, in respect to a lighthouse on the Wolf Rock, near Land's End; but the first actually made was for Jamaica, in 1842; it consisted chiefly of thick cast-iron plates riveted together. A few others have since been built; and there seems reason to believe that the great success attending the use of wrought-iron sheets in the tubular and girder bridges, will lead to the substitution of this material for cast-iron plates in lighthouses. The iron lighthouse made by Messrs. Fox and Henderson for the East India Company, in 1850, and which is 70 feet high, is principally formed of cast-iron plates; but the lighthouse made by Messrs. Walker in 1851 for the American Government, and intended for Florida, consists chiefly of corrugated wrought-iron sheets.



# POPULAR ASTRONOMY.

## LETTER XVIII.—(continued.)

Although the sun sheds by day a dim and cheerless light, yet the six satellites that enlighten and diversify the nocturnal sky present interesting aspects. "Let us suppose one satellite presenting a surface in the sky eight or ten times larger than our moon; a second, five or six times larger; a third, three times larger; a fourth, twice as large; a fifth, about the same size as the moon; a sixth, somewhat smaller; and perhaps, three or four others of different apparent dimensions: let us suppose two or three of those, of different phases, moving along the concave of the sky, at one period four or five of them dispersed through the heavens, one rising above the horizon, one setting, one on the meridian, one towards the north, and another towards the south; at another period, five or six of them displaying their lustre in the form of a half moon, or a crescent in one quarter of the heavens; and, at another time, the whole of these moons shining, with full enlightened hemispheres, in one glorious assemblage, and we shall have a faint idea of the beauty, variety, and sublimity of the firmament of Uranus."\*

*The New Planets, Ceres, Pallas, Juno, and Vesta.*—The commencement of the present century was rendered memorable in the annals of astronomy, by the discovery of four new planets, occupying the long vacant tract between Mars and Jupiter. Kepler, from some analogy which he found to subsist among the distances of the planets from the sun, had long before suspected the existence of one at this distance; and his conjecture was rendered more probable by the discovery of Uranus, which follows the analogy of the other planets. So strongly, indeed, were astronomers impressed with the idea that a planet would be found between Mars and Jupiter, that, in the hope of discovering it, an association was formed on the continent of Europe, of twenty-four observers, who divided the sky into as many zones, one of which was allotted to each member of the association. The discovery of the first of these bodies was, however, made accidentally by Piazzi, an astronomer of Palermo, on the 1st of January, 1801. It was shortly afterwards lost sight of on account of its proximity to the sun, and was not seen again until the close of the year, when it was re-discovered in Germany. Piazzi called it *Ceres*, in honour of the tutelary goddess of Sicily, and her emblem, the sickle ( $\rho$ ), has been adopted as its appropriate symbol.

The difficulty of finding *Ceres* induced Dr. Olbers, of Bremen, to examine with particular care all the small stars that lie near her path, as seen from the earth; and, while prosecuting these observations, in March, 1802, he discovered another similar body, very nearly at the same distance from the sun, and resembling the former in many other particulars. The discoverer gave to this second planet the name of *Pallas*, choosing for its symbol the lance, ( $\gamma$ ) the characteristic of Minerva.

The most surprising circumstance connected with the discovery of *Pallas* was the existence of two planets at nearly the same distance from the sun, and apparently crossing the ecliptic in the same part of the heavens, or having the same node. On account of this singularity, Dr. Olbers was led to conjecture that *Ceres* and *Pallas* are only fragments of a larger planet, which had formerly circulated at the same distance, and been shattered by some internal convulsion. The hypothesis suggested the probability that there might be other fragments, whose orbits might be expected to cross the ecliptic at a common point, or to have the same node. Dr. Olbers, therefore, proposed to examine carefully, every month, the two opposite parts of the heavens in which the orbits of *Ceres* and *Pallas* intersect one another, with a view to the discovery of other planets, which might be sought for in those parts with a greater chance of success, than in a wider zone, embracing the entire limits of these orbits. Accordingly, in 1804, near one of the nodes of *Ceres* and *Pallas*, a third planet was

\* Dick's "Celestial Scenery."

discovered. This was called *Juno*, and the character ( $\text{♃}$ ) was adopted for its symbol, representing the starry sceptre of the Queen of Olympus. Pursuing the same researches in 1807, a fourth planet was discovered, to which was given the name of *Vesta*, and for its symbol the character ( $\text{♄}$ ) was chosen,—an altar surmounted with a censer holding the sacred fire.

The *average distance* of these bodies from the sun is two hundred and sixty one millions of miles; and it is remarkable that their orbits are very near together. Taking the distance of the earth from the sun for unity, their respective distances are 2.77, 2.77, 2.67, 2.37. Their *times* of revolution around the sun are nearly equal, averaging about four and a half years.

In respect to the *inclination of their orbits* to the ecliptic, there is also considerable diversity. The orbit of *Vesta* is inclined only about seven degrees, while that of *Pallas* is more than thirty-four degrees. They all, therefore, have a higher inclination than the orbits of the old planets, and of course make excursions from the ecliptic beyond the limits of the zodiac. Hence they have been called the *ultra-zodiacal planets*. When first discovered, before their place in the system was fully ascertained, it was also proposed to call them *asteroids*, a name implying that they were planets under the form of stars. Their title, however, to take their rank among the primary planets, is now generally conceded.

The *eccentricity of their orbits* is also, in general, greater than that of the old planets. You will recollect that this language denotes that their orbits are more elliptical, or depart further from the circular form. The eccentricities of the orbits of *Pallas* and *Juno* exceed that of the orbit of *Mercury*. The asteroids differ so much, however, in eccentricity, that their orbits may cross each other. The orbits of the old planets are so nearly circular, and at such a great distance apart, that there is no danger of their interfering with each other. The earth, for example, when at its nearest distance from the sun, will never come so near it as *Venus* is when at its greatest distance, and therefore can never cross the orbit of *Venus*. But since the average distance of *Ceres* and *Pallas* from the sun is about the same, while the eccentricity of the orbit of *Pallas* is much greater than that of *Ceres*, consequently *Pallas* may come so near to the sun at its perihelion, as to cross the orbit of *Ceres*.

The *small size* of the asteroids constitutes one of their most remarkable peculiarities. The difficulty of estimating the apparent diameter of bodies at once so very small and so far off, would lead us to expect different results in the actual estimates. Accordingly, while Dr. Herschel estimates the diameter of *Pallas* at only eighty miles, *Schroeter* places it as high as two thousand miles, or about the diameter of the moon. The volume of *Vesta* is estimated at only one fifteen thousandth part of the earth's, and her surface is only about equal to that of the kingdom of Spain.

These little bodies are surrounded by *atmospheres* of great extent, some of which are uncommonly luminous, and others appear to consist of nebulous matter, like that of comets. These planets shine with a more vivid light than might be expected, from their great distance and diminutive size; but a good telescope is essential for obtaining a distinct view of their phenomena.

Although the great chasm which occurs between *Mars* and *Jupiter*,—a chasm of more than three hundred millions of miles,—suggested long ago the idea of other planetary bodies occupying that part of the solar system, yet the discovery of the asteroids does not entirely satisfy expectation, since they are bodies so dissimilar, to the other members of the series in size, in appearance, and in the form and inclinations of their orbits. Hence Dr. Olbers, the discoverer of three of these bodies, held that they were fragments of a single large planet, which once occupied that place in the system, and which exploded in different directions by some internal violence. Of the fragments thus projected into space, some would be propelled in such directions and with such velocities, as, under the force of projection and that of the solar attraction, would make them revolve in regular orbits around the sun. Others would be so projected among the other bodies in the system, as to be thrown in very irregular orbits, apparently wandering lawless through the skies. The larger fragments would



receive the least impetus from the explosive force, and would therefore circulate in an orbit deviating less than any other of the fragments from the original path of the large planet; while the lesser fragments, being thrown off with greater velocity, would revolve in orbits more eccentric, and more inclined to the ecliptic.

Dr. Brewster, editor of the "Edinburgh Encyclopædia," and the well-known author of various philosophical works, espoused this hypothesis with much zeal; and after summing up the evidence in favour of it, he remarks as follows:—"These singular resemblances in the motions of the greater fragments, and in those of the lesser fragments, and the striking coincidences between theory and observation in the eccentricity of their orbits, in their inclination to the ecliptic, in the position of their nodes, and in the places of their perihelia, are phenomena which could not possibly result from chance, and which concur to prove, with an evidence amounting almost to demonstration, that the four new planets have diverged from one common node, and have therefore composed a single planet."

The same distinguished writer supposes that some of the smallest fragments might even have come within reach of the earth's attraction, and by the combined effects of their projectile forces, and the attraction of the earth, be made to revolve around this body as the larger fragments are carried around the sun; and that these are in fact the bodies which afford those *meteoric stones* which are occasionally precipitated to the earth. It is now a well-ascertained fact—a fact which has been many times verified in our own country, that large meteors, in the shape of fire-balls, traversing the atmosphere, sometimes project to the earth masses of stony or ferruginous matter. Such were the meteoric stones which fell at Weston, in Connecticut, in 1807, of which a full and interesting account was published, after a minute examination of the facts, by Professors Silliman and Kingsley, of Yale College. It is for the production of these wonderful phenomena that Dr. Brewster supposes the explosion of the planet, which, according to Dr. Olbers, produced the asteroids, accounts. Others, however, as Sir John Herschel, have been disposed to ascribe very little weight to the doctrine of Olbers.

## LETTER XIX.

### FIXED STARS.

"O majestic Night!  
Nature's great ancestor! Day's elder born,  
And fated to survive the transient sun!  
By mortals and immortals seen with awe!  
A starry crown thy raven brow adorns,  
An azure zone thy waist; clouds, in Heaven's loom  
Wrought, through varieties of shape and shade,  
In ample folds of drapery divine,  
Thy flowing mantle form; and Heaven throughout  
Voluminously pour thy pompous train."—*Young*.

SINCE the solar system is but one among a myriad of worlds which astronomy unfolds, it may appear to you that I have dwelt too long on so diminutive a part of creation, and reserved too little space for the other systems of the universe. But however humble a province our sun and planets compose, in the vast empire of Jehovah, yet it is that which most concerns us; and it is by the study of the laws by which this part of creation is governed, that we learn the secrets of the skies.

Until recently, the observation and study of the phenomena of the solar system almost exclusively occupied the labours of astronomers. But Sir William Herschel gave his chief attention to the *sidereal heavens*, and opened new and wonderful fields of discovery, as well as of speculation. The same subject has been prosecuted with similar zeal and success by his son, Sir John Herschel, and Sir James South, in England, and by Professor Struve, of Dorpat, until more has been actually achieved than preceding astronomers had ventured to conjecture. A limited sketch of these wonderful discoveries is all that I propose to offer you.

The fixed stars are so called, because, to common observation, they always maintain the same situations with respect to one another. The stars are classed by their apparent *magnitudes*. The whole number of magnitudes recorded are *sixteen*, of which the first six only are visible to the naked eye; the rest are *telescopic stars*. These magnitudes are not determined by any very definite scale, but are merely ranked according to their relative degrees of brightness, and this is left, in a great measure, to the decision of the eye alone. The brightest stars, to the number of fifteen or twenty, are considered as stars of the first magnitude; the fifty or sixty next brightest, of the second magnitude; the next two hundred, of the third magnitude: and thus the number of each class increases rapidly, as we descend the scale, so that no less than fifteen or twenty thousand are included within the first seven magnitudes.

The stars have been grouped in *constellations* from the most remote antiquity; a few, as Orion, Bootes, and Ursa Major, are mentioned in the most ancient writings, under the same names as they bear at present. The names of the constellations are sometimes founded on a supposed resemblance to the objects to which they belong; as the Swan and the Scorpion were evidently so denominated from their likeness to those animals; but in most cases, it is impossible for us to find any reason for designating a constellation by the figure of the animal or hero which is employed to represent it. These representations were probably once blended with the fables of pagan mythology. The same figures, absurd as they appear, are still retained for the convenience of reference; since it is easy to find any particular star, by specifying the part of the figure to which it belongs; as when we say, a star is in the neck of Taurus, in the knee of Hercules, or in the tail of the Great Bear. This method furnishes a general clue to its position; but the stars belonging to any constellation are distinguished according to their apparent magnitudes, as follows: First, by the Greek letters, Alpha, Beta, Gamma, &c. Thus, *Alpha Orionis* denotes the largest star in Orion; *Beta Andromedæ*, the second star in Andromeda; and *Gamma Leonis*, the third brightest star in the Lion. When the number of the Greek letters is insufficient to include all the stars in a constellation, recourse is had to the letters of the Roman alphabet, a, b, c, &c.; and in all cases where these are exhausted, the final resort is to numbers. This is evidently necessary, since the largest constellations contain many hundreds or even thousands of stars. *Catalogues* of particular stars have also been published, by different astronomers, each author numbering the individual stars embraced in his list according to the places they respectively occupy in the catalogue. These references to particular catalogues are sometimes entered on large celestial globes. Thus we meet with a star marked 84 H., meaning that this is its number in Herschel's catalogue; or 140 M., denoting the place the star occupies in the catalogue of Mayer.

The earliest catalogue of the stars was made by Hipparchus, of the Alexandrian school, about one hundred and forty years before the Christian era. A new star appearing in the firmament, he was induced to count the stars, and to record their positions, in order that posterity might be able to judge of the permanency of the constellations. His catalogue contains all that were conspicuous to the naked eye in the latitude of Alexandria, being one thousand and twenty-two. Most persons, unacquainted with the actual number of the stars which compose the visible firmament, would suppose it to be much greater than this; but it is found that the catalogue of Hipparchus embraces nearly all that can now be seen in the same latitude; and that on the equator, where the spectator has both the northern and southern hemispheres in view, the number of stars that can be counted does not exceed three thousand. A careless view of the firmament in a clear night, gives us the impression of an infinite number of stars; but when we begin to count them, they appear much more sparsely distributed than we supposed, and large portions of the sky appear almost destitute of stars.

By the aid of the telescope, new fields of stars present themselves, of boundless extent; the number continually augmenting, as the powers of the telescope are increased. Lalande, in his "*Histoire Celeste*," has registered the position of no less



than fifty thousand; and the whole number visible in the largest telescopes amounts to many millions.

When you look at the firmament on a clear autumnal or winter evening, it appears so thickly studded with stars, that you would perhaps imagine that the task of learning even the brightest of them would be almost hopeless. Let me assure you, this is all a mistake. On the contrary, it is a very easy task to become acquainted with the names and positions of the stars of the first magnitude, and of the leading constellations. If you will give a few evenings to the study, you will be surprised to find, both how rapidly you can form these new acquaintances, and how deeply you will become interested in them. I would advise you, at first, to obtain, for an evening or two, the assistance of some friend who is familiar with the stars, just to point out a few of the most conspicuous constellations. This will put you on the track, and you will afterwards experience no difficulty in finding all the constellations and stars that are particularly worth knowing; especially if you have before you a map of the stars, or, what is much better, a celestial globe. It is a pleasant evening recreation for a small company of young astronomers to go out together, and learn one or two constellations every favourable evening, until the whole are mastered. If you have a celestial globe, *rectify* it for the evening; that is, place it in such a position, that the constellations shall be seen on it in the same position with respect to the horizon, that they have at that moment in the sky itself. To do this, I first elevate the north pole until the number of degrees on the brass meridian from the pole to the horizon corresponds to my latitude (forty-one degrees and eighteen minutes). I then find the sun's place in the ecliptic, by looking for the day of the month on the broad horizon, and against it noting the corresponding sign and degree. I now find the same sign and degree on the ecliptic itself, and bring that point to the brass meridian. As that will be the position of the sun at noon, I set the hour index at twelve, and then turn the globe westward, until the index points to the given hour of the evening. If I now inspect the figures of the constellations, and then look upward at the firmament, I shall see that the latter are spread over the sky in the same manner as the pictures of them are painted on the globe. I will point out a few marks by which the leading constellations may be recognised; this will aid you in finding them, and you can afterwards learn the individual stars of a constellation, to any extent you please, by means of the globes or maps. Let us begin with the *Constellations of the Zodiac*, which, succeeding each other, as they do, in a known order, are most easily found.

*Aries (the Ram)* is a small constellation, known by two bright stars which form his head, *Alpha* and *Beta Arietis*. These two stars are about four degrees apart; and directly south of *Beta*, at the distance of one degree, is a smaller star, *Gamma Arietis*. It has been already intimated that the Vernal equinox probably was near the head of Aries, when the signs of the zodiac received their present names.

*Taurus (the Bull)* will be readily found by the seven stars, or *Pleiades*, which lie in his neck. The largest star in Taurus is *Aldebaran*, in the Bull's eye, a star of the first magnitude, of a reddish colour, somewhat resembling the planet Mars. Aldebaran and four other stars, close together in the face of Taurus, compose the *Hyades*.

*Gemini (the Twins)* is known by two very bright stars, *Castor* and *Pollux*, five degrees asunder. Castor (the northern) is of the first, and Pollux of the second, magnitude.

*Cancer (the Crab.)* There are no large stars in this constellation, and it is regarded as less remarkable than any other in the zodiac. It contains, however, an interesting group of small stars, called *Praesepe*, or the nebula of Cancer, which resembles a comet, and is often mistaken for one, by persons unacquainted with the stars. With a telescope of very moderate powers this nebula is converted into a beautiful assemblage of exceedingly bright stars.

*Leo (the Lion)* is a very large constellation, and has many interesting members. *Regulus (Alpha Leonis)* is a star of the first magnitude, which lies directly in the ecliptic, and is much used in astronomical observations. North of Regulus, lies

a semicircle of bright stars, forming a *sickle*, of which Regulus is the handle. *Denebola*, a star of the second magnitude, is in the Lion's tail, twenty-five degrees north-east of Regulus.

*Virgo* (the *Virgin*) extends a considerable way from west to east, but contains only a few bright stars. *Spica*, however, is a star of the first magnitude, and lies a little east of the place of the autumnal equinox. Eighteen degrees eastward of *Denebola*, and twenty degrees north of *Spica*, is *Vindemiatrix*, in the arm of *Virgo*, a star of the third magnitude.

*Libra* (the *Balance*) is distinguished by three large stars, of which the two brightest constitute the beam of the balance, and the smallest forms the top or handle.

*Scorpio* (the *Scorpion*) is one of the finest of the constellations. His head is formed of five bright stars, arranged in the arc of a circle, which is crossed in the centre by the ecliptic nearly at right angles, near the brightest of the five, *Beta Scorpionis*. Nine degrees south-east of this, is a remarkable star of the first magnitude, of a reddish colour, called *Cor Scorpionis*, or *Antares*. South of this, a succession of bright stars, sweep round towards the east, terminating in several small stars, forming the tail of the Scorpion.

*Sagittarius* (the *Archer*.) North-east of the tail of the Scorpion are three stars in the arc of a circle, which constitute the *bow* of the Archer, the central star being the brightest, directly west of which is a bright star which forms the *arrow*.

*Capricornus* (the *Goat*) lies north-east of *Sagittarius*, and is known by two bright stars, three degrees apart, which form the head.

*Aquarius* (the *Water-Bearer*) is recognised by two stars in a line with *Alpha Capricorni*, forming the shoulders of the figure. These two stars are ten degrees apart; and three degrees south-east is a third star, which, together with the other two, make an acute triangle, of which the westernmost is the vertex.

*Pisces* (the *Fishes*) lie between *Aquarius* and *Aries*. They are not distinguished by any large stars, but are connected by a series of small stars, that form a crooked line between them. *Piscis Australis*, the Southern Fish, lies directly below *Aquarius*, and is known by a single bright star far in the south, having a declination of thirty degrees. The name of this star is *Fomalhaut*, and it is much used in astronomical measurements.

The constellations of the zodiac, being first well learned, so as to be readily recognized, will facilitate the learning of others that lie north and south of them. Let us, therefore, next review the principal *Northern Constellations*, beginning north of *Aries*, and proceeding from west to east.

*Andromeda* is characterised by three stars of the second magnitude, situated in a straight line, extending from west to east. The middle star is about seventeen degrees north of *Beta Arietis*. It is in the girdle of *Andromeda*, and is named *Mirach*. The other two lie at about equal distances, fourteen degrees west and east of *Mirach*. The western star, in the head of *Andromeda*, lies in the equinoctial colure. The eastern star, *Alamak*, is situated in the foot.

*Perseus* lies directly north of the *Pleiades*, and contains several bright stars. About eighteen degrees from the *Pleiades* is *Algol*, a star of the second magnitude, in the head of *Medusa*, which forms a part of the figure; and nine degrees north-east of *Algol* is *Algenib*, of the same magnitude, in the back of *Perseus*. Between *Algenib* and the *Pleiades* are three bright stars, at nearly equal intervals, which compose the right leg of *Perseus*.

*Auriga* (the *Wagoner*) lies directly east of *Perseus* and extends nearly parallel to that constellation, from north to south. *Capella*, a very white and beautiful star of the first magnitude, distinguishes this constellation. The feet of *Auriga* are near the Bull's horns.

The *Lynx* comes next, but presents nothing particularly interesting, containing no stars above the fourth magnitude.

*Leo Minor* consists of a collection of small stars north of the sickle in *Leo*, and south of the Great Bear. Its largest star is only of the third magnitude.



*Coma Berenices* is a cluster of small stars, north of Denebola, in the tail of the Lion, and of the head of Virgo. About twelve degrees directly north of Berenice's hair, is a single bright star, called *Cor Caroli*, or Charles's Heart.

*Bootes*, which comes next, is easily found by means of *Arcturus*, a star of the first magnitude, of a reddish colour, which is situated near the knee of the figure. *Arcturus* is accompanied by three small stars, forming a triangle a little to the south-west. Two bright stars, *Gamma* and *Delta Bootis*, form the shoulders, and *Beta*, of the third magnitude, is in the head of the figure.

*Corona Borealis* (the Crown), which is situated east of *Bootes*, is very easily recognised, composed as it is of a semicircle of bright stars. In the centre of the bright crown is a star of the second magnitude, called *Gemma*: the remaining stars are all much smaller.

*Hercules*, lying between the Crown on the west and the Lyre on the east, is very thickly set with stars, most of which are quite small. This constellation covers a great extent of the sky, especially from north to south, the head terminating within fifteen degrees of the equator, and marked by a star of the third magnitude, called *Ras Algethi*, which is the largest in the constellation.

*Ophiucus* is situated directly south of *Hercules*, extending some distance on both sides of the equator, the feet resting on the Scorpion. The head terminates near the head of *Hercules*, and, like that, is marked by a bright star within five degrees of *Alpha Herculis*. *Ophiucus* is represented as holding in his hands the *Serpent*, the head of which, consisting of three bright stars, is situated a little south of the Crown. The folds of the serpent will be easily followed by a succession of bright stars, which extend a great way to the east.

*Aquila* (the Eagle) is conspicuous for three bright stars in its neck, of which the central one, *Altair*, is a very brilliant white star of the first magnitude. *Antinous* lies directly south of the Eagle, and north of the head of *Capricornus*.

*Delphinus* (the Dolphin) is a small but beautiful constellation, a few degrees east of the Eagle, and is characterised by four bright stars near to one another, forming a small rhombic square. Another star of the same magnitude, five degrees south, makes the tail.

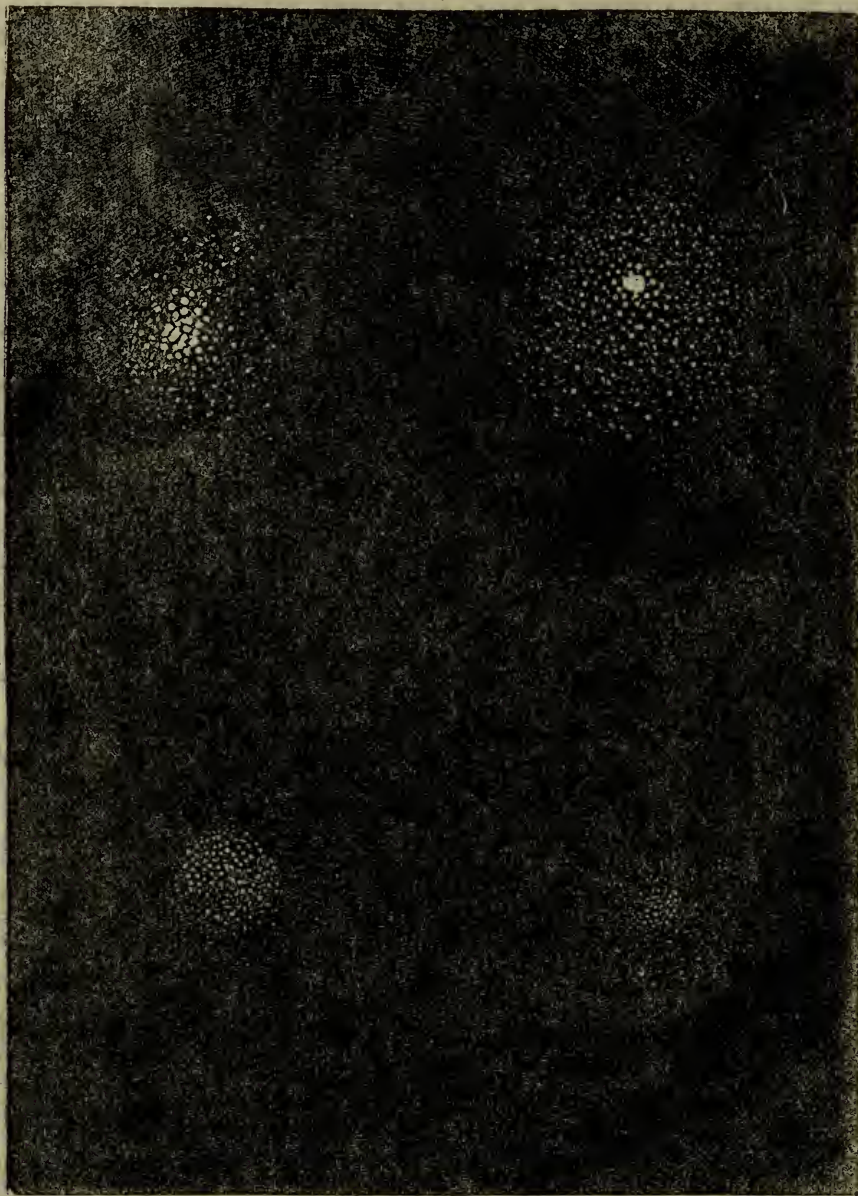
*Pegasus* lies between *Aquarius* on the south-west and *Andromeda* on the north-east. It contains but few large stars. A very regular square of bright stars is composed of *Alpha Andromedæ* and the three largest stars in *Pegasus*; namely, *Scheat*, *Markab*, and *Algenib*. The sides composing this square are each about fifteen degrees. *Algenib* is situated in the equinoctial colure.

We may now review the *Constellations which surround the north pole*, within the circle of perpetual apparition.

*Ursa Minor* (the Little Bear) lies nearest the pole. The pole-star, *Polaris*, is in the extremity of the tail, and is of the third magnitude. Three stars in a straight line four degrees or five degrees apart, commencing with the pole-star, lead to a trapezium of four stars, and the whole seven form together a *dipper*,—the trapezium being the body and the three stars the handle.

*Ursa Major* (the Great Bear) is situated between the pole and the Lesser Lion, and is usually recognised by the figure of a larger and more perfect dipper which constitutes the hinder-part of the animal. This has also seven stars, four in the body of the dipper and three in the handle. All these are stars of much celebrity. The two in the western side of the dipper, *Alpha* and *Beta*, are called *pointers*, on account of their always being in a right line with the pole-star, and therefore affording an easy mode of finding that. The first star in the tail, next to the body, is named *Alioth*, and the second, *Mizar*. The head of the Great Bear lies far to the westward of the pointers, and is composed of numerous small stars; and the feet are severally composed of two small stars very near to each other.

*Draco* (the Dragon) winds round between the Great and the Little Bear; and, commencing with the tail, between the pointers and the pole-star, it is easily traced by a succession of bright stars extending from west to east. Passing under *Ursa Minor*, it



Figs. 61, 62, 63 & 64.—CLUSTERS OF STARS AND NEBULÆ.

returns westward, and terminates in a triangle which forms the head of Draco, near the feet of Hercules, north-west of Lyra. *Cepheus* lies eastward of the breast of the Dragon, but has no stars above the third magnitude.

*Cassiopeia* is known by the figure of a *chair*, composed of four stars which form the legs, and two which form the back. This constellation lies between Perseus and Cepheus, in the Milky Way.

*Cygnus* (*the Swan*) is situated also in the Milky Way, some distance south-west of Cassiopeia, towards the Eagle. Three bright stars, which lie along the Milky Way, form the body and neck of the Swan, and two others, in a line with the middle one of



the three, one above and one below, constitute the wings. This constellation is among the few that exhibit some resemblance to the animals whose names they bear.

*Lyra* (the *Lyre*) is directly west of the Swan, and is easily distinguished by beautiful white star of the first magnitude, *Alpha Lyrae*.

The *Southern Constellations* are comparatively few in number. I shall notice only the Whale, Orion, the Greater and Lesser Dog, Hydra, and the Crow.

*Cetus* (the *Whale*) is distinguished rather for its extent than its brilliancy, reaching as it does through forty degrees of longitude, while none of its stars, except one, are above the third magnitude. *Menkar* (*Alpha Ceti*) in the mouth, is a star of the second magnitude; and several other bright stars, directly south of Aries, make the head and neck of the Whale. *Mira* (*Omicron Ceti*), in the neck of the Whale, is a variable star.

*Orion* is one of the largest and most beautiful of the constellations, lying south-east of Taurus. A cluster of small stars forms the head; two large stars, *Betalgeus* of the first and *Bellatrix* of the second magnitude, make the shoulders; three more bright stars compose the buckler, and three the sword; and *Rigel*, another star of the first magnitude, makes one of the feet. In this constellation there are seventy stars plainly visible to the naked eye, including two of the first magnitude, four of the second, and three of the third.

*Canis Major* lies south-east of Orion, and is distinguished chiefly by its containing the largest of the fixed stars, *Sirius*.

*Canis Minor*, a little north of the equator, between *Canis Major* and *Gemini*, is a small constellation, consisting chiefly of two stars, of which, *Procyon* is of the first magnitude.

*Hydra* has its head near *Procyon*, consisting of a number of stars of ordinary brilliancy. About fifteen degrees south-east of the head is a star of the second magnitude, forming the heart (*Cor Hydræ*); and eastward of this is a long succession of stars of the fourth and fifth magnitudes, composing the body and tail, and reaching a few degrees south of *Spica Virginis*.

*Corvus* (the *Crow*) is represented as standing on the tail of *Hydra*. It consists of small stars, only three of which are as large as the third magnitude.

In assigning the places of individual stars, I have not aimed at great precision; but such a knowledge as you will acquire of the constellations and larger stars, by nothing more even than you can obtain from the foregoing sketch, will not only add greatly to the interest with which you will ever afterwards look at the starry heavens, but it will enable you to locate any phenomenon that may present itself in the nocturnal sky, and to understand the position of any object that may be described, by assigning its true place among the stars; although I hope you will go much further than this mere outline, in cultivating an actual acquaintance with the stars. Leaving now these great divisions of the bodies of the firmament, let us ascend to the next order of stars, composing CLUSTERS.

In various parts of the nocturnal heavens are seen large groups which, either by the naked eye, or by the aid of the smallest telescope, are perceived to consist of a great number of small stars. Such are the *Pleiades*, *Coma Berenices*, and *Præsepe*, or the Bee-hive, in *Cancer*. The *Pleiades*, or Seven Stars, as they are called, in the neck of Taurus, is the most conspicuous cluster. When we look *directly* at this group, we cannot distinguish more than six stars; but by turning the eye *sideways* upon it, we discover that there are many more; for it is a remarkable fact that indirect vision is far more delicate than direct. Thus we can see the zodiacal light or a comet's tail much more distinctly and better defined, if we fix one eye on a part of the heavens at some distance and turn the other eye obliquely upon the object, than we can by looking directly towards it. Telescopes show the *Pleiades* to contain fifty or sixty stars, crowded together, and apparently insulated from the other parts of the heavens. *Coma Berenices* has fewer stars, but they are of a larger class than those which compose the *Pleiades*. The *Bee-hive*, or *Nebula of Cancer*, as it is called, is one of the finest objects of this kind for a small telescope, being by its aid converted into a rich con-



Fig. 65.—VARIOUS FORMS OF NEBULÆ.

series of shining points. The head of Orion affords an example of another cluster, though less remarkable than those already mentioned. These clusters are pleasing objects to the telescope; and since a common spy-glass will serve to give a distinct view of most of them, every one may have the power of taking the view. But we pass, now, to the third order of stars, which present themselves much more obscurely to the gaze of the astronomer, and require large instruments for the full development of their wonderful organization. These are the NEBULÆ.





Fig. 66.—A NEBULÆ IN THE MILKY WAY

Nebulæ are faint misty appearances which are dimly seen among the stars, resembling comets, or a speck of fog. They are usually resolved by the telescope into myriads of small stars; though, in some instances, no powers of the telescope have been found sufficient thus to resolve them. The *Galaxy* or Milky Way, presents a continued succession of large Nebulæ. The telescope reveals to us innumerable objects of this kind. Sir William Herschel has given catalogues of two thousand



nebulae, and has shown that the nebulous matter is distributed through the immensity of space, in quantities inconceivably great, and in separate parcels, of all shapes and sizes, and of all degrees of brightness between a mere milky appearance and the condensed light of a fixed star. In fact, more distinct nebulae have been hunted out by the aid of telescopes than the whole number of stars visible to the naked eye in a clear winter's night. Their appearances are extremely diversified. In many of them we can easily distinguish the individual stars; in those apparently more remote, the interval between the stars diminishes, until it becomes quite imperceptible; and in their faintest aspect they dwindle to points so minute, as to be appropriately denominated *star-dust*. Beyond this, no stars are distinctly visible, but only streaks or patches of milky light. The diagram, on page 311, represents a magnificent nebulae in the Galaxy. In objects so distant as the fixed stars, any apparent interval must denote an immense space; and just imagine yourself situated anywhere within the grand assemblage of stars, and a firmament would expand itself over your head like that of our evening sky, only a thousand times more rich and splendid.

Many of the nebulae exhibit a tendency towards a globular form, and indicate a rapid condensation towards the centre. This characteristic is exhibited in the forms presented in Figs. 61, 62, 63 and 64. We have here two specimens of nebulae of the nearer class, where the stars are easily discriminated. In Figs. 63 and 64, we have examples of two others of the remoter kind, one of which is of the variety called *star-dust*. These wonderful objects, however, are not confined to the spherical form, but exhibit great varieties of figure. Sometimes they appear as ovals; sometimes they are shaped like a fan; and the unresolvable kind often affect the most fantastic forms. The diagrams on pages 310, 311, afford specimens of these varieties, as given in Professor Nichols's "Architecture of the Heavens," where they are faithfully copied from the papers of Herschel, in the "Philosophical Transactions."

Sir John Herschel, the celebrated philosopher, resided five years at the Cape of Good Hope, with the express view of exploring the hidden treasures of the southern hemisphere. The kinds of nebulae are in general similar to those of the northern hemisphere, and the forms are equally various and singular. The *Magellan Clouds*, two remarkable objects seen among the stars of that hemisphere, and celebrated among navigators, appeared to the great telescope of Herschel (as we are informed by Professor Nichols) no longer as simple milky spots, or permanent light flocculi of cloud, as they appear to the unassisted eye, but shone with inconceivable splendour. The *Nubecula Major*, as the larger object is called, is a congeries of clusters of stars, of irregular form, globular clusters and nebulae of various magnitudes and degrees of condensation, among which is interspersed a large portion of irresolvable nebulous matter,—which may be, and probably is *star-dust*, but which the power of the twenty feet telescope shows only as a general illumination of the field of view, forming a bright ground on which the other objects are scattered. The *Nubecula Minor* (the lesser cloud), exhibited appearances similar, though inferior in degree.

It is a grand idea, first conceived by Sir William Herschel, and generally adopted by astronomers, that the whole Galaxy or Milky Way, is nothing else than a nebula, and appears so extended merely because it happens to be that particular nebula to which we belong. According to this view, our sun, with his attendant planets and comets, constitutes but a single star of the Galaxy, and our firmament of stars, or visible heavens, is composed of the stars of our nebula alone. An inhabitant of any of the other nebulae would see spreading over him a firmament equally spacious, and in some cases inconceivably more brilliant.

It is an exalted spectacle to travel over the Galaxy in a clear night, with a powerful telescope, with the heart full of the idea that every star is a world. Sir William Herschel, by counting the stars in a single field of his telescope, estimated that fifty thousand had passed under his review in a zone two degrees in breadth, during a single hour's observation. Notwithstanding the apparent contiguity of the stars which crowd the Galaxy, it is certain that their mutual distances must be inconceivably great.

(To be continued.)



## THE MIRROR OF NATURE.

*(Continued from page 288.)*

*Aërial Navigation.*—An iron anchor let down into the sea immediately sinks, drawn by its own weight into the flood below, and drags down with it even the cable to which it is fastened, until it reaches the firm ground which will not let it sink any deeper. The water of the Dead Sea, by virtue of the many saline parts which it contains dissolved in it, is so thick and heavy that a man, who has never learned to swim, can keep himself up upon it without any trouble; while a piece of chalk, although its proportionate gravity is much less than that of a pebblestone, sinks in the same water to the bottom. But even a piece of iron does not sink in fluid mercury, but floats thereon as easily as a piece of cork on water. As a little piece of elder-pith, loaded at one end with lead, to the amusement of our children, always takes a position with the heavy end down and the light end up; so in all fluids, the body which is lighter than the fluid rises, and that which is heavier sinks to the bottom.

The art of travelling on water was invented and practised in the earliest times; for the method of travelling thus was very obvious. The means of navigating the water were offered by the whole vegetable world, by almost every tree; for there are but a few kinds of wood, such as boxwood and mahogany, so much heavier than water, that they sink in it. Most other kinds float, because the solid parts, of which they are composed, are not so closely and firmly united as the component parts of a stone. Yet even a vessel made of iron, beaten out thin, floats on the water, because its cavity contains chiefly only atmospheric air, which is 770 times lighter than water.

The wish to sail about, not only on the water, but in and on the airy ocean of the atmosphere, must have often been awakened in man, when he saw the inhabitants of the air, birds and winged insects, hovering and flying about with so much ease in that element. To the birds especially, this is made possible, because their bodies within as well as without contain a multitude of cavities, which are filled with air, for the quills of their feathers, and

even their bones, disclose such cavities; and, in the interior of their bodies, there are spaces connected with the lungs, which fill with air by means of the process of breathing. In addition to these facts there is the admirable arrangement of the wings and tail-feathers, which, when spread out, not only form a natural parachute, but their steering movement is preserved, effected as it is by the force of the muscles,—an arrangement, whose perfection human art has striven in vain to imitate. What, however, the hand has failed to accomplish, has been all the more successfully achieved by the imagination with its fabulous inventions; for as Dædalus and Icarus were said to have escaped from the prison of Minos, by means of waxen wings; so it was fabled also of a great mathematician of antiquity, Archytas, that he invented a wooden dove that flew in the air like a living bird.

These and similar fictions afterwards invented, nevertheless, found people here and there who held them for true, and were accordingly tempted to experiments which cost several of them their lives. Whether the Italian, Giovanni Battista Dante, of Perugia, at the end of the fifteenth century, by means of his flying machine, really passed several times across the Trasimenian Lake, ere he fell in attempting to take wing from a certain eminence, remains a question. At least the bold adventurer came off with his life, although he broke his leg, because fortunately for him he fell upon a tower; while a similar attempt to fly cost the learned Olivier de Malmesbury, in England, and Backwell, in Padua, their lives.

To swim in the water is quite a different thing from swimming in the air. The human body is not heavier, indeed it is lighter than water; while its specific weight is to that of the air almost a hundred times greater than that of iron is to that of water. In consideration of this fact, some learned men, as Lana, in Brescia, and Sturm, at Altdorf (near Nuremberg), the former in 1670, the latter in 1678, declared that the elevation of a solid, ship-shaped body in the air, could be effected only by connecting with it hollow balls, weighing less than the air, and on this account rising in the air of themselves. The invention of the air-

pump by Otto von Guericke, twenty years before, appeared to furnish the means of carrying out this idea. For a hollow ball exhausted of air, if the material were not too heavy, must needs, so it appeared, ascend in the air. But of what should such a ball be made, in order to be strong enough to resist the enormous pressure of the atmosphere? This pressure amounts to 2,216 $\frac{2}{3}$  lbs. on every square foot of the earth's surface; a thin metal plate is collapsed by it, and the thickest bladder, stretched over a vacuum, is burst in. Hence, not altogether out of the way was the idea of Father Galien at Avignon, stated in 1755, that such balls must be, not empty, but filled only with a specifically lighter kind of air, whose elasticity may resist the external pressure; adventurous as may appear the proposal, that the needed kind of air should be brought from the upper and rarer regions of the atmosphere. We are not reduced to the necessity of attempting such a trip, in order to fill the hollow balls or air-tight bags, according to Galien's proposal, with a gas, resembling common air in elasticity, but as much lighter than the air as water is in comparison with mercury. The celebrated English chemist, Henry Cavendish (born at Nizza, in 1731, died, 1810, in London), a man alike rich in mind and fortune, in the year 1766 discovered the great levity of hydrogen gas; and thus a new era was opened in the history of *aërostation*. Soap-bubbles, filled with inflammable air, Kratzenstein saw in 1776 ascend with extraordinary swiftness into the air; Cavallo's experiments in 1782 failed, however, because silk paper let the air escape, and bladders were too heavy.

There yet remained, comparatively speaking, only a slight difficulty to be overcome, which lay in the preparation of an air-tight material, of which the balloon was to be made. This last remaining step was soon taken by two individuals, who, although not professionally men of science, have thereby won for themselves an enduring name in the history of inventions, the brothers, Stephen and Robert Mongolfier, proprietors of a paper-factory at Annonay, in Vivarais. In the year 1782, they succeeded on a small scale, simply by means of heated air, in raising balloons

to the height of the ceiling, and then to the height of a house; and these experiments, the simplicity of which would now excite a smile, created far and near a great excitement; and this excitement rose still higher when the brothers succeeded in preparing a balloon, tolerably airtight, of linen, the inside of which was lined with paper, and the diameter of which was 110 feet. This balloon had an opening below, into which heated air passed from a fire, kept up below by straw and carded wool, set on fire. The comparatively greater levity of the air, rarefied by the heat, caused the balloon, when it was filled, not only to ascend, although its weight was 450 lbs.; but also to carry up an additional weight of more than 400 lbs., and indeed with such rapidity, that in the space of twenty minutes, it reached a height of 6,000 feet. and was carried by the wind, which that day (the 5th of June), was not very strong—a distance of three-quarters of a league—when it fell to the earth.

The newspapers were full of accounts of this first victory, achieved by man over an obstacle, which places him below the bird; but a few months later, the public prints had much more important triumphs to tell of. Professor Charles, in Paris, availing himself of the aid of the brothers Mongolfier, in preparing his balloon, which was made of taffeta, and rendered apparently perfectly air-tight by means of a resinous varnish, was the first to employ, instead of rarefied air, hydrogen gas, to fill the balloon, which was only 12 feet in diameter, and which, at the first trial, made August 27, 1783, on the Champ de Mars, rose about 3,000 feet, then was lost from sight in the clouds, but after three-quarters of an hour, began to descend towards the maternal bosom of the earth, and alighted five leagues from the place of its ascent.

Scientific men, and all the friends of the newborn art of sailing in the air, would have preferred that the balloon, like the dove let loose from the ark, should not have returned, but continued its course unseen by human eye—who knows now long? in the upper regions of the atmosphere, for thus it would have been proved that the sides of the hollow taffeta ball were sufficiently air-tight to permit no



escape of the inflammable air, which must have the effect to cause the balloon to descend. To obtain this quality of impermeability, M. Romain, of Paris, employed a newly-invented varnish, by means of which, a balloon, which the brewer Caps made at Dantzic, appears actually to have resembled Noah's dove, for after being kept filled for three months with inflammable air, without suffering any diminution, upon being removed into the open air, it escaped from the light cords, by which it was held, and what direction it has taken over land and sea, no one knows.

As yet no living being had mounted into the air with the *aërostatic ball*, and the first who enjoyed this honour could tell nothing of any experiments made during the air-voyage, although a barometer was placed in their basket; for these first voyagers of the air, whom the younger *Mongolfier* caused to ascend on the 19th September, at Versailles, in the presence of the king, were a ram, a cock, and a duck. The excursion which these three took, by no will of their own, however, succeeded perfectly. They descended unhurt to the earth about a league from Paris. What the ram, the cock, and the duck, had succeeded in doing, might safely be attempted by man. The first trial, however, was made with great caution. The balloon, which four weeks after the ascent of the aforesaid animals, rose with *Pilate de Rozier*, a man of science, was held so firmly by cords that he ascended only to the height of 84 feet, and was drawn down again after a lapse of four minutes. A somewhat bolder attempt, made by the same gentleman four days afterwards, (October 19,) was successful, although the cords of the balloon caught in some trees. The spirit for such an adventure now rose to such a height, that the *Marquis d'Arlandes* offered himself as a companion to the young *Rozier*, in the next somewhat bolder excursion, which was made on the 21st of November, from the castle *La Muette*, on which occasion the two adventurers were in the space of twenty-five minutes borne to a considerable height, and to a distance of nearly three leagues from *La Muette*. They came unharmed to the ground, and not a little delighted at the suc-

cess of the journey. Their example instantly excited the emulation of others. *Charles* especially, who had been one of the first among the inventors of *aërostation*, and who was resolved not to be left behind in the application of the new art, now undertook (December 1) a voyage into the air, in company with one of the brothers *Mongolfier*, which, in its splendid and successful execution, left all previous attempts far behind. The most distinguished point in the capital, the *Tuilleries*, was selected for the ascent. Twenty minutes before two o'clock, P.M., the beautiful balloon, in a blaze of sunlight, and made of vari-coloured taffeta, was seen to rise, carrying with it, hung by cords, a sort of triumphal car, in which the two cloud-stormers were seated. They soon rose to five or six times the height of the steeples of the city, and, at this height of nearly 1,800 feet, they surrendered the balloon to the moderate wind that was blowing, which bore them to a distance of nine leagues from Paris, into the neighbourhood of *Nesle*. *Monsieur Robert*, having had enough of the cool journey, in order to cause the balloon to descend, opened certain valves, by which a portion of the light inflammable air escaped, and an equal quantity of the heavier atmospheric air was admitted. The balloon sank to the earth; *Monsieur Robert* alighted on *terra firma*, and *Monsieur Charles*, closing the valves, again rose. The balloon, now lighter by 130 lbs., rose once more to a height of 9,000 feet, the height of the summit of *Mount Etna*. The annoyances of the icy coldness and rarefied air in that region of perpetual frost were outweighed, not only by the enjoyment afforded by the grand outlook over the country under the light of the setting sun, but even more by the thought that hitherto no denizen of earth had ever attained to so bold a flight. The car in which the happy mortal sate, had not in vain the form of a triumphal chariot, when, after five and thirty minutes, it descended in a wood not far from *Tour du Lay*, and *Monsieur Charles* disembarked unharmed and in fine spirits; the art of man celebrated one of its most imposing victories.

But now another man, one of the most fortunate adventurers of his time, appeared

upon the stage, Francis Blanchard, who made a greater talk in all countries than all his predecessors and companions on this new career of glory. Blanchard, born 1738, at Andely, in the department d'Eure, was a mechanic by profession, and from his youth up had busied himself with all sorts of schemes and experiments, having for their aim the invention of a flying-machine. Without ceasing, asleep or awake, his lively imagination was practising the art of flying. At last, after labouring twelve years to realise his dream, he fancied he had succeeded. He went to Paris in 1782, some months before Mongolfier showed his balloon in that city, and first requiring money to enable him to prepare his flying ship, he announced in pompous terms his approaching excursion in the air, promising to rise into the highest regions of the atmosphere by means of the four wings of his strange ship. Arriving there, he would achieve an immense distance in a short time, would descend here and there at pleasure, and even alight on the water, as his machine was to be so arranged as to be fitted to navigate the ocean. He was to dart through the air swifter than the raven, without losing breath, as he would be provided with a mask, ingeniously constructed to obviate that difficulty. Even against the wind, but only not in a storm, he would pursue his course, more slowly indeed, but nevertheless with greater rapidity than the best sailing ship with a fair wind.

This boastful announcement appeared in the widely-read *Daily*, of Paris, and in thousands of ignorant heads awakened the liveliest agitation of interest and curiosity. The delirium spread among all classes; so that the great mathematician and astronomer, Lalande, considered it a duty to address a letter to the editor of the daily print, in which he abundantly showed the absurdity of Blanchard's scheme of flying in the air by mechanical means. The seducing influence, however, which the folly of one man, when it is accompanied with unusual self-confidence, exercises upon other men, manifested itself in this instance. Many indeed doubted, some sneered, while others, among whom was the engineer and engraver to the king, Martinet, maintained the possibility of

Blanchard's scheme, and were as anxious as the credulous mass to witness the proposed experiment. When the day came which the half-foolish mechanic appointed to show his winged air-ship to the curious public, the crowd was so great and the space for the spectacle so small, that the affair had to be postponed. The universal curiosity was, however, to be gratified on another day, the 26th of August, and public notice was given by Martinet, that, if no serious obstacles intervened, Blanchard would ascend into the air before the eyes of all Paris. But such obstacles did actually intervene. Monsieur Blanchard, having succeeded so well in raising the wind, on the appointed day, allowed much to be heard but nothing to be seen of him. The show-loving public might hold itself indemnified for its disappointed expectations by the sight of four copper-plates, by Monsieur Martinet, representing the adventurous air-ship in front and behind, outside, and in.

Blanchard, with his boastings, retreated into oblivion, and he would scarcely have emerged again, had not the discovery made shortly afterwards by the brothers Mongolfier and Professor Charles come to the help of this true child of fortune in the realization of his dreams. Suddenly, after a number of air voyages had been made by the help of the balloon, Blanchard, ever befriended by the wind, again appeared before the public with an air-ship of his own invention, in which, however, the balloon was the principal part, while it presented in addition a couple of wings on each side, a rudder, an anchor-line, and below a huge parachute. The man was resolved to outstrip all his predecessors, not merely by ascending into the air, but also by going where he pleased in the sky like a bird.

Perhaps, the accident that befell this artificial contrivance upon the occasion when it was first to be tried, in the beginning of March, 1784, happened not wholly inopportunately. A student, who was resolved to press himself on Blanchard as a companion of the voyage, in his furious zeal broke the wings and parachute of the machine; and when Blanchard, nevertheless, prepared to ascend, provided merely with the rudder and the anchor-line, the promised bird's flight was of course not



to be expected of him. The spectators had to be satisfied with the assurance of the self-satisfied air-sailor, that he would mount just as high as Rosier did, and that was 9,000 feet. In the same month Blanchard delighted the inhabitants of Rouen with an air-voyage, when an accident again occurred—the wind breaking the rudder and leaving only the wings uninjured. Once again in Ronen, but several times afterwards, in quick succession, in England, he carried on his lucrative trade, and thus his confidence in his good fortune grew so, that he raised himself to his boldest deed—crossing the Channel from England to France. A balloon, filled with hydrogen gas, which had already made five ascents without any accident, bore the car, in which, together with Blanchard, an American (Dr. Jeffries), was seated. In the presence of an immense multitude the two heroes of the air rose, January 7, 1785, at Dover, and mounted, borne by the wind, several steeples high over the tossing sea. But they soon found cause to rue their boldness. The gas escaped so rapidly that the balloon threatened to fall into the water. The *aéronauts* threw out their 30 lbs. of ballast, and then all the articles which they had taken with them, and even a part of their clothes, into the ocean roaring beneath them. They would have been lost, however, if the wind had not borne them just at the right moment towards the French coast, in the vicinity of which the balloon again rose and floated on without injury into the forest of Guienne, a league from Calais. A monument erected there in honour of Blanchard, was designed to preserve the memory of his exploit, the success of which the king of France rewarded with a present of 12,000 francs, and with the assurance of an annuity of 1,200 francs.

This ignorant adventurer, who was destitute of all knowledge, scientific or mathematical: who, in his extravagant self-estimation announced himself everywhere as “*aéronaut* of both hemispheres, citizen of the principal cities of both worlds, member of foreign academies,”—thus succeeded without consideration or due foresight in an enterprise, which was shortly afterwards undertaken at the cost of his life by an excellent man, thoroughly instructed, who ventured not upon the

attempt until after all care had been taken, and all the helps secured, which science could afford. Blanchard's history shows us how fortune can raise a man, even when understanding is wanting. It shows us, that the admiration of a crowd of contemporaries furnishes no standard of real merit. With all his fortunate excursions into the upper sky—of which, at his death in 1809, he numbered 66, he rendered no essential service to science or to posterity, although some have wished to ascribe to him the invention of the parachute, which properly belongs to Stephen Mongolfier,—that parachute, by means of which he let himself down several times from considerable heights, for the amusement of spectators, in different countries of Europe and America; and a knowledge of which was of no use to his wife, who carried on his trade after his death; when in July, 1819, she ascended at Paris, in order on a beautiful summer night to delight the crowd with a discharge of fireworks from the balloon, by which the balloon caught fire, and the poor heroine fell to the earth and perished.

While Blanchard's name and achievements everywhere excited the greatest admiration, and appeared to cast in the shade all similar enterprises, the scientific and enlightened authors and promoters of the new art were silently engaged in endeavouring to perfect it, and render it more secure. The chemist Rozier had gone to Lyons to the elder Mongolfier; and, in company with him, had prepared a balloon of more than 12,000 cubic feet contents. In an ascent made with this balloon, and in which Rozier was accompanied with seven other persons, it was proved that the danger increased with the size of the balloon; for the gigantic ball, when it had risen to a height of 3,000 feet, suffered, after fifteen minutes, a rent. It fortunately descended, however, without injury, to the earth. All the attempts of Mongolfier, and of Messrs. Alban and Vallet, to regulate the horizontal motion of the balloon by means of a rudder, proved fruitless; and their repetition by others has had no successful result. On the other hand, Rozier, and, after him, several others, especially Count Zambecari, succeeded by a very simple method, in regulating the rising and descending of the *Mongolfiere*. A spirit-lamp was

connected\* with the balloon; and, by the opening and closing of certain valves, the lamp could be kindled or extinguished. The heating, and consequent expansion of the air in the balloon, could be increased or diminished by a slight increase or diminution of the flame of the lamp; so that, in a few seconds, the balloon could be driven to a greater height, or be made to descend in a few minutes to the ground. Although, however, the greatest possible care was taken in adjusting such a circular, ringformed lamp to the mouth of the Mongolfiere below, yet this arrangement was attended with great danger, as the spirits were liable to be shaken by the frequent and sudden gusts of wind to which the balloon was exposed, and thus the balloon itself might be set on fire. An accident of this sort probably led to the unfortunate result of the second attempt to cross the British Channel, made by the French *aéronauts*. This second attempt to pass through the air over the sea promised a result at least as favourable as that of the former attempt by Blanchard; for the person who undertook it was a thorough chemist; the season most favourable, and all the preparations for the voyage were made with the greatest care. In order, by mean of his lamp-apparatus, to regulate his ascent or descent, Rozier provided himself with a Mongolfiere in addition to, and placed below the balloon, which was filled with hydrogen. Like Blanchard, Rozier took a companion with him—the parliamentary advocate Romain, from Boulogne. Blanchard had passed from England to France. The present excursion was the reverse, starting from Calais for Dover. The 14th of June was appointed for the ascent. Soon after seven, A. M., the balloon rose majestically with the two men of science; the south-east wind, into whose current they passed at some height, appeared to bear them straight towards their goal. But soon the wind set in east; and this change was followed by one still more unfavourable—a current of air carried the balloon from the sea back again towards the French coast. The two gallant men were at least to find their graves on their native soil, and not in the waves. The inflammable air of the upper balloon, in the dangerous vicinity of the Mongol-

fieri probably took fire—the whole machine fell from a great height with indescribable rapidity and violence to the earth, and the fragments lay scattered on the ground a league and a half from Boulogne, only a few hundred steps from the sea; the bodies of the *aéronauts* were so mangled, that the human form was hardly to be recognised. Their remains were buried at Vimile. Thus perished a man for whom one would have wished a better fate; because, among all, he was the first to entrust his own person to an air-ship, and to rise with it into the uncertain element; and because he had done so much for the advancement of that art to which his life was sacrificed.

This was the first instance in which the newly-invented art had had so frightful a result. For, with the exception of the French painter Bouche,—who, however, when his balloon at Aranjuez took fire, had saved himself by a leap,—there had taken place up to that time (1785) thirty-five ascents by fifty-eight different persons, and no accident had occurred. Among these adventurers was Madame Thibie, at Lyons, the first of her sex who trusted herself to a balloon, and who achieved the excursion, June 4, 1784. The charm of the novel and beautiful art was so powerful, and so heightened by the continued success of Blanchard and others, that the fate of Rozier and Romain could not prevent these aerial excursions from becoming more frequent and general. Among the most interesting adventures of this kind is that of Crosbie especially, who ascended at Dublin, with the design of crossing the Channel between Ireland and England. His car was adapted equally to the air and to the water, and to this construction he owed his rescue from destruction. For the wind, at first favourable, and promising to bear him straight to England, changed to the north-east; the bold man soon found himself forty English miles from the Irish coast, at a height from which he could see indeed both England and Ireland; but where the pleasure, which this grand prospect would have given him under other circumstances, was very much lessened by the effect of the surrounding air upon his body. For although below, on the earth, the hot July sun shone with full power, at the height at which the



aëronaut found himself, it was so cold that the ink which he took with him was frozen, and the quicksilver in the thermometer sank into the ball. This, however, was not the greatest calamity of that excursion. Crosbie had let off a portion of the gas, in order to descend into a lower, milder region; when he had reached which, he was borne by a north-wind through a cloud, in which he saw lightnings and heard thunder, his air-ship gradually sinking lower and lower, until the waves beat into the car, the balloon driving all the while before the wind, and dragging the car along with it towards the English coast, where a vessel came to the assistance of the aëronaut, and took him and his balloon safely into port.

(To be continued.)

## HINTS TO TEACHERS.

### CONDUCTING RECITATIONS.

THE recitation is the best test of the teacher as well as of the scholar. If a teacher possesses ability, here is the place where it is exhibited; for it is the grand theatre of his operations. The principal means of improvement in this respect, are found in conversation with those of greater experience, in reading, in observation, and in judicious experiments. But as skill in conducting recitations involves many of the requisites of a good teacher, it must not be imagined that it is a thing to be attained by an off-hand effort, or by following any set of rules:

It is not the hasty product of a day,  
But the well-ripened fruit of sage delay.

In this article we aim at nothing more than to drop a few hints which may be useful to beginners; and to answer though imperfectly, that question which they are apt to ask themselves as they stand before their classes—*How shall I proceed in order to render this exercise as pleasant and profitable as possible?*

As a preliminary step in attempting to reach this result, it is important to give pupils definite and particular directions as to the manner of preparing their lessons, the manner in which they will be expected to recite. The difficulties they will be likely to meet should be anticipated; and though not solved and

cleared up, such hints should be thrown out as the case may require.

*Attention* is the most important thing now to be required of the pupils; undivided attention, the attention of the whole class as long as the recitation continues. An important question was put to a pupil, which he could not answer, and he pleaded in excuse, with eyes filled with tears, that it was not in the book, and he had never heard it before. But the fact was, that it had been discussed and answered in his presence on the day previous, while he was inattentive, and so he was none the wiser for what had been said about it. Instruction is wasted on minds while in such a state. It is seed sown by the wayside. Attention is a fundamental requisite of a good recitation, and must be secured at any cost, for without it the best of instruction can neither be understood nor retained. The teacher should leave no expedient untried till he has succeeded here; for it is idle to attempt other conquests, while this victory remains to be achieved. The attention of young scholars is soon wearied, and it is very injudicious to drag their jaded minds through long recitations. Their mental repasts should be short and sweet; they will come to them then with a sharp appetite, though often called. There are two kinds of attention: that which is caused by an interest in the subject under consideration, and that which is yielded from a sense of duty, or under the pressure of necessity. The former should be aimed at when it is desirable to deposit knowledge in the memory safely. The latter is useful as a mental discipline. When the Athenian orator was asked what was the most important thing in speaking, he replied, *action*; the second requisite, *action*; the third, *action*. And I would say the same of attention in recitation.

*Energy* is another essential requisite in a good recitation. It should enter into every action, however minute and trivial. In rising up and in sitting down, in the posture of the body, and holding the book, it should be constantly insisted upon. Indistinct utterance is not unfrequently the result of a slothful habit of using the organs of speech, especially the tongue and lips. In such cases energy is the only

remedy. The organs of the body, as well as the faculties of the mind, should be trained to prompt and vigorous action in every exercise in the recitation where it is possible.

Energy should be well tempered with the attractive grace of gentleness. It may be useful also to bear in mind, that there is a marked difference between energy and noise—a difference similar to that between lightning and thunder. The literal meaning of energy is *inward-workingness*; and where it really exists, it will make itself felt, though speaking in a “still small voice.”

The example of the teacher is the best mode of securing energetic habits in pupils. Energy is contagious. Let the teacher be active, brisk, and decisive in his manner, and the same qualities will be reflected in his pupils. On the other hand, whoever found a class anything but tame and listless in the hands of a teacher *eminent* for sluggishness and inactivity? There is no better rule on this subject than that in the holy proverb, “Whatever our hand finds to do, let us do it with all our might.”

*Encouragement*, when judiciously applied, is a powerful agent in promoting the objects of recitation. It is what scholars of all grades need. Children must have it, or they will not succeed. Encouragement in education is like the sun in the natural world; nothing can supply its place. The teacher who knows how to dispense his smiles of approbation, wields a greater power than ever slept in the rod, or was contained in the language of censure and reproach. Make a pupil *think* he can do a thing, and he *can* do it. This is a consideration which requires particular attention, as teachers are constantly prone to bestow the largest share of encouragement where it is least needed. How much more are the bright and bold scholars praised, and cheered on, than the dull and timid!

*Exactness* is a quality which should be rigorously demanded in recitation. There can be no such thing as good scholarship or good instruction without it. In pronunciation, it is not enough to avoid inaccuracies; the utterance should be complete in every respect, and free from all defects. Fragments of sentences, and

incoherent phrases, should not be received as answers to questions. It fosters a slovenly habit of expression, and robs the pupil of the best practical means of acquiring readiness and correctness in the use of language.

In every recitation it should be the aim of the teacher to call into exercise as many faculties as possible; for it is only by exercising them that they can be developed and perfected. When it is possible, principles should be deduced from the particular facts under consideration, the pupils made to see how much more valuable the knowledge of one general truth is, than the knowledge of many facts. Every sort of routine in recitation should be avoided. The teacher who would be very successful must tax his invention to find out ways of varying the exercises, though always keeping the great end in view.

## FAMILIAR CONVERSATIONS ON INTERESTING SUBJECTS.

“MOTHER, what makes a black dress warmer than a light one?”

“You have never worn a black dress, Clara, how do you know that it is?”

“Why, I have often heard persons say so, but I did not know whether it was true, or whether it was only imagination.”

“It is not imagination, Clara, it is true. All black or dark dresses are warmer than light ones, because they absorb more heat. You recollect I told you yesterday, that all dull and dark substances were good radiators of heat, and that a good radiator was a good absorber also, consequently, as black absorbs more heat than any other colour, it is the warmest colour we could select for a dress; but on the other hand, that which absorbs the least heat, reflects the most; so that if we wish a cool dress, we should select a white one.”

“Will a white surface reflect light as well as heat, mother?”

“Yes; that which reflects heat, reflects light also, and whatever absorbs heat, absorbs light.”

“Then is not that the reason, mother, why, when sitting opposite a fence that has been newly whitewashed, the light is so painful to our eyes?”



"Yes; the rays of light falling upon the white surface, are reflected to our eyes, which being too much for the nerve of the eye, cause us to experience pain."

"How is it, mother, that when we come into the house, after having been out in the bright sunshine, the place at first seems so dark that we can scarcely see at all, but, after a few minutes, it appears quite light enough to enable us to see every object distinctly?"

"You know that there is a certain portion of the eye which in some persons is black, in others blue, and in others gray. You have noticed this, I suppose, Clara?"

"Yes, mother, and in the centre of it is another little round spot, which is always black."

"Yes; and this little spot of which you speak, is called the pupil; that which surrounds it, is called the iris, which is a sort of network, which contracts or expands according to the force of the light in which it is placed. The pupil is nothing more than an opening or window, through which light is admitted, which strikes on the retina or back part of the eye, which is the most important part of the eye, for it is that which receives the impression of the objects of sight and conveys it to the mind. When a person is out in the sunshine, or near a strong light, the pupil is very small, and the iris very large, and this is the reason why, when we at first enter a dark room, we are unable to distinguish any thing: because the pupil being small, enough light cannot be admitted to render any object visible; but in a few minutes the pupil dilates, and the iris contracts, and we clearly perceive every object around us."

"But why is it, mother, that when we come from a dark room into a strong light, we feel so much pain in our eyes?"

"Because, when we come suddenly into a strong light, before the pupil has time to contract, the nerve of the eye is overburdened with the quantity of light admitted."

"What is it, mother, that makes some persons near-sighted?"

"The whole of the outside or visible part of the eyeball, is termed the cornea. Now, when the cornea projects too much, the impression of objects is not formed on the retina, but in the humours of the eye,

and their image is therefore not distinctly seen."

"How does wearing glasses relieve them, mother?"

"Such persons should wear double concave glasses, or glasses hollowed-in on both sides, which cause the rays of light to diverge, and prevent their coming to a focus too soon, and thus the image is cast farther back, and formed on the retina."

"Sometimes such persons bring objects close to their eyes; how does that help them, mother?"

"It has a similar effect to that produced by the glasses, for the nearer an object is brought to the eye the greater is the angle under which it is seen, and the more its rays are diverged; or, to use plain language, the distance between the cornea and retina, that is, the front and back of the eye being so much greater in near-sighted persons than it is in others, the image of objects when held at the usual distance from the eye is formed on the humours in front of the retina, which causes it to be imperfect; but when the object is brought near to the eye, the image is thrown further back, and consequently the impression of the object falls on the retina."

"Well, mother, some persons again hold objects at a distance—why do they do that?"

"Because the cornea is not convex enough; in other words, it is too flat, so that the distance between the front and the back of the eye is not enough, and to compensate for this defect they are obliged to hold objects at a distance; this is generally the case with old persons, the humours of the eye being dried up with age, the cornea or outside of the eye sinks."

"What kind of glasses should such persons use, mother?"

"Double convex glasses, or glasses which curve outward on both sides, for these have the property of converging the rays, and bringing them to a focus, thus forming an image on the retina. Reflect a moment, my child, on this small, yet I think I may say, most wonderful part of the human body. What wisdom! what skill is displayed in its mechanism! Could the most ingenious person on earth have devised anything parallel with it? At a

single glance, a landscape several miles in extent is brought into a space, half an inch in diameter; and yet, not one of the multitude of objects which it contains is lost; all are correctly represented, with their various colours, magnitudes, and positions. Does not this single member of our body loudly declare, 'the hand that made us is divine?' But, we will proceed with our lesson. You have heard of microscopes, have you not, Clara?"

"Yes, frequently."

"Do you understand their use?"

"They are used for magnifying small objects, are they not mother?"

"They are; and by their aid we are enabled to notice still further, the superiority of the works of God over those of man."

"In what way, mother?"

"The edge of a sharp lancet appears very smooth and fine to the naked eye; but when viewed through a microscope it is rough and uneven, and full of notches. But the sting of a bee, seen through the same instrument, is without the least flaw, or inequality, and ends in a point so small that it cannot be discerned. The threads of the finest lawn appear rougher than the yarn with which the coarsest ropes are made; but a silkworm's web is perfectly smooth and equal. A dot with a pen is irregular and uneven, but the little specks on the wings of insects are perfectly circular."

"Oh, mother, how I should like to look at some of these things through a microscope!"

"It would not only be gratifying, but highly instructive to you, my child, if you could do so; but, as that is a matter of impossibility just now, you must content yourself with listening to what those who have enjoyed this privilege have discovered."

"That I am quite willing to do, mother; please tell me some more of these wonders."

"How does a grain of sand appear, when viewed by the eye, Clara?"

"Round, mother."

"And yet, when viewed through a microscope, scarcely two appear of the same shape: some are round, some are square, some conical, and the greater part irregular. By the help of microscopes,

which magnify millions of times, we discover that within the cavity of these grains dwell numerous insects."

"Oh, mother, that appears almost impossible."

"To our feeble minds it does; but shall we limit the power of the Almighty? A drop of water or vinegar, by this instrument, is also shown to contain numbers of small insects. But there is scarcely an end to these wonders. The wing of the smallest insect, the leaf of the most insignificant plant that we trample beneath our feet, when viewed through a microscope fill us with admiration and astonishment, and lead us involuntarily to exclaim, 'Surely there is a God.'"

#### COMMON ABBREVIATIONS.

A.B or B.A.—Bachelor of Arts. Abp.—Archbishop. Aect.—Accempt. Ans.—Answer. A.D.—The year of our Lord. A.M.—The year of the world. A.M.—Master of Arts. A.M.—Before noon. Ap.—April. A.U.C.—Year of the building of Rome. Aug.—August. Bart.—Baronet. Bp.—Bishop. B.C.—Before Christ. Capt.—Captain. C. cent.—A hundred. Chap.—Chapter. Col.—Colonel. Co.—Company. Cr.—Creditor. Cwt.—A hundred weight. D. denarius—a penny. D.C.L.—Doctor of Civil Laws. D.D.—Doctor of Divinity. Do. ditto.—the same, the aforesaid. Dr.—Doctor, and Debtor. Dec.—December. 12mo.—Duodecimo, 12 leaves in a sheet. E.—East. E.g.—for example. Etc. or &c.—Et cætera. Exon.—Exeter. F.A.S.—Fellow of the Antiquarian Society. F.L.S.—Fellow of the Linnean Society. F.R.S.—Fellow of the Royal Society. Fol.—Folio, two leaves in a sheet. Feb.—February. Gen.—General. Gent.—Gentleman. G.R.—Gulielmus Rex, William the King. G.C.B.—Grand Cross of the Bath. Ibid. or ib.—the same. Idem, id.—the same. i. e. id est.—that is. Inst.—Instant, the present month. Int.—Interest. Jan.—January. J.H.S.—Jesus Hominum Salvator, Jesus the Saviour of men. K.B.—Knight of the Bath. K.G.—Knight of the Garter. Kt.—Knight. K.T.—Knight of the Thistle. lb.—pound weight. £.—Libra, pound, (money.) L.D.—Lady



Day. Ldp.—Lordship. L.L.D.—Doctor of Laws. L.—Liber, a book. Lieut.—Lieutenant. M.A. or A.M.—Master of Arts. M.B.—Bachelor of Music (or Medicine). Messrs.—Gentlemen. M.D.—Doctor of Medicine. M.S.—Sacred to the Memory. M.S.—Manuscript. M.S.S.—Manuscripts. N.B.—Mark well. n.l.—Non liquet, it appears not. Ncv.—November. N.S.—New Style. Oct.—October. O.S.—Old Style. Olymp.—Olympiad. 8vo.—Octavo, eight leaves in a sheet. Oxon. Oxford. Parl.—Parliament. P.S.—Postscript. Per cent.—By the Hundred. P.M.—Afternoon. 4to.—Quarto, four leaves in a sheet. q. d.—As if he should say. q. l.—As much as you please. q. s.—A sufficient quantity. R.—Rex, King. Rev.—Reverend. Reg. Prof.—Regius Professor. Rt. Hon.—Right Honourable. Rt. Wpful.—Right Worshipful. S.—Solidus, a shilling. Sept.—September. S.T.P.—Professor of Sacred Theology, or Divinity. St.—Saint. Ult.—Ultimo, last month. Vide.—See. Viz.—That is to say. Wp.—Worship. Xmas.—Christmas.

A WORD TO YOUNG MEN.—“Wishing and sighing, imagining and dreaming of greatness,” said William Wirt, “will not make you great.” But cannot a young man command his energies? Read Foster, on “Decision of Character.” That book will tell you what is in your power to accomplish; you must gird up your loins, and go to work with all the indomitable energy of Hannibal scaling the Alps. It is your duty to make the most of time, talents, and opportunities. Alfred, King of England, though he performed more business than any one of his subjects, found time to study. Frederick the Great, with an Empire at his direction, in the midst of war and on the eve of battle, found time to revel in the charms of philosophy, and feast on luxuries of science. Napoleon, with Europe at his disposal, with kings in his ante-chamber, and at the head of thousands of men whose destinies were suspended on his arbitrary pleasure, found time to converse with books. And young men, who are confined to business even to twelve hours a day, may take an hour and a half of what is left for study, and which will amount to two months in the course of a year.

## EASTERN RAMBLES AND REMINISCENCES.

## RAMBLE THE TWENTY-NINTH.

PUG AND HIS AUTHORITY—LEAVING THE PEIRÆUS—CAPE COLONNA—A STORM IN KARYSTOS BAY—CHALCIS AND THE NEGROPONT—THE BRIDGE OVER THE EURIPUS, AND RUINED AQUEDUCT—THE RUINS OF RHAMNIS, HISTORICAL AND ORIGINAL REFLECTIONS—MARATHON, ITS HISTORY, ANTIQUITY, AND ASSOCIATIONS—ÆGINA, ITS HISTORICAL, ANTIQUARIAN AND MODERN ASSOCIATIONS—NAPOLIDE—ROMANIA, ITS VICISSITUDES AND APPEARANCES—FAREWELL TO GREECE.

“The mountains look on Marathon,  
And Marathon looks on the sea;  
And musing there an hour alone,  
I dream’d that Greece might still be free;  
For standing on the Persian’s grave,  
I could not deem myself a slave.”

The sun, the soil, but not the slave, the same;  
Unchanged in all except its foreign lord—  
Preserves alike its bounds and boundless fame.”

BYRON.

“Know’st thou the land where the citron blows,  
Where midst its dark foliage the gold orange  
glows?

Thither, thither, let us go.”

GOETHE.

“Why need we say that Ægina is one of the most celebrated of islands—the native country of Æacus and the Æcidæ, which once enjoyed the dominion of the seas, and contended with Athens itself for the prize of superior glory in the battle with the Persian fleet of Salamis.”—STRABO.

“SHOVE off there for’ard—bear a hand now and give way,” shrieked a small naval cadet, who soon expected to mount the midshipman’s white patch, and who had obtained the *sobriquet* of “Pug” for his ugliness and mischievous propensities. “Do you hear there, give way, or I’ll report you when we get on board.”

It was a slight show of authority on the part of Pug; but it favoured us a little, for the pinnace shot ahead in fine style, as the men “gave way,” and we were quickly alongside of Her Majesty’s steamer. Five minutes sufficed to clear the pinnace of our few traps, and stow them away below; and we were soon pacing the quarter-deck with our naval friends as comfortably as if we were on board our own vessel.



ÆGINA, ITS PEAK AND PEOPLE.

The anchor had left its muddy bed, the steam was up, and we were soon sweeping merrily out of the Peiræus, leaving a crowd of small boats with their forest of masts, and a long track of hissing foam far behind us. Salamis and Ægina soon became lost in the haze of distance, or the mist of night; and we had little else to amuse us upon deck, beyond watching the phosphorescent foam of the Ægean waves, the star-bespangled heavens, or playing backgammon and whist below.

While the heavens were yet tinged with the hues of the sun that had already set, we neared "Collonna's Cliff that gleams along the wave," and saw the remnant columns of the once beautiful temple

standing upon its summit, "in solitude sublime."

The night looked threatening, the stars shone dimly, as if through a thick mist, the wind howled, the sea-birds screamed, and sudden squalls, announcing a storm, induced us to run into Karystos Bay, and anchor for the night. 'Twas well we did so, for many vessels of the country were wrecked, or sucked into the whirling waves. As night advanced the storm increased, and the only sounds heard were the bell indicating the hours and half hours, the steady pace of the sentry, and the roaring of the raging elements without.

Morning dawned, but it was not a joyous one; the wind no longer warned us with dreary and hollow moans, but whistling through the rigging, went roaring over the bay, lashing the sea into a fury, and strewing the surf-beaten sands with fragments of vessels that yesterday were triumphantly riding over the Ægean waters. The sable clouds grew thicker and more foreboding; and then poured out the pent-up rain with increased vio-



lence; the blue lightnings glared upon the leaping waves, sometimes playing upon the masts of the ship, and at others uprooting giant trees, or dealing desolation around the Grecian homes; the full-toned thunder rolled from hill to hill, booming along the sky, deepening and crashing in its course; and

“ Tempests in contention roar,  
From land to sea, from sea to land;  
The vex'd sea foams—waves leap and moan,  
And hide the rocks with insult hoarse.”

Towards night the warring winds died away; the echoes of the thunder were replaced by the sigh of Nature; the sky became clear and fair, bedecked with twinkling stars, and illumined by the silvery light of the moon, and the ocean, partaking in the repose of Nature, wooed us with the soft music of its silvered waves, rolling with tranquil motion upon the sandy shore.

A morning bright and genial made us ample amends for the gloom of yesterday, and having weighed anchor, under the advantages of a fair wind and steam, we soon reached Chalcis, now called Egripos, which is the chief town of Eubœa.

Eubœa, is an island now called the Negropont, and lies along the coasts of Attica and Bœotia, from which it is separated by the Euripus, which has a bridge built over its narrow channel, so as to connect the mainland with the island. As I did not measure the island, of course it cannot be expected that I can state its exact dimensions; and, perhaps, if my readers were informed of the measurements of others, it would not benefit them greatly.

If we believe some very old authors, we shall of course take it for granted that an Ionian colony from Athens came to this part after the siege of Troy, and finding that it was exactly the spot they required, forthwith and without much ado, settled down and founded Egripos. Homer tries to make us believe that it was a most excellent place, long before the Trojan war; but his opponents are too many for him, and we feel bound to give way to the public opinion of the many—authors.

Historians have informed us that the inhabitants were great navigators, but somewhat given to indulge in potations deep, and other like abuses, so that they

were universally reproached for their dissolute manners. In the palmy days of Venice, Eubœa was considered one of its best possessions, and jealously guarded. In proof of this we merely advert to the standard of the Eubœans at St. Mark's, Venice, one of the prize-pet trophies of the republic.

Mahomet the Second reduced Chalcis, and for many years afterwards it was the residence of the Capitan Pasha, the High-admiral of the Turkish fleets.

Its soil is very good, its people peaceful, and its crops plentiful. The mountains yield copper and the quarries near Karystos fine marble. A good shot may bag a few nice hares and rabbits in the plains, and have some sport with the wild boar and deer in the mountains, and if he only knows how to cook his game, he may be envied by the gents of the London clubs.

Egripos has been taken care of by the engineer; that is to say, it is better than some towns, but infinitely worse than many. It is walled, turreted, and defended with such formidable cannon, that if they were fired, it is doubtful whether they would burst, go off, or shake down the slight walls on which they are placed, and which are most irregularly built.

The town has rotten gates, deserted bazaars, thieves, guides who only mislead, very narrow streets, large houses chiefly inhabited by fleas, some very bad bread, and extremely dirty and disodorous inhabitants, who exact much and expect little, except from the *Verdes*. A few neat sketches may be made opposite to the town, and some nice little artistic bits may be caught outside the town; space obliges me to remember that artists should not always linger over sweet scenes, otherwise the reader might be tortured with the description of some nice Negropontine bits.

Over the gate of the Kastro of Egripos, may still be seen the winged lion of St. Mark, and many square towers, huge shot that cannot be fired, guns that will not go, and perhaps have not gone, off, are to be seen as some of the wonders of the place. The fortress has evidently been constructed by instalments, each age contributing its share, for some parts were built before gunpowder was invented, others are Venetian, and some Turkish.

Alas! Chalcis is almost forgotten, and but for a few fragments of marble in the walls of the mosques and houses, it is probable that its name might have been classed with the cities that were, and of which we have no relics, and are unable to determine their sites.

On the north side of Egripos there is a bay called St. Minas, and on the south there is another called Vurko, or Vulko from its being muddy and shallow; there is a narrow opening between three and four miles long which connects this bay with another part of the Eubœan coast, called the Plain of Vasiliko, where there is a tower.

Between a mount called Karababa and the Kastro is a narrow strait called the Euripus, which is divided into two unequal parts by a picturesque castle which stands upon a rock, and is generally a favourite object with travelling artists, being what is generally termed "a nice little bit." The castle is square, but has a round tower at its north-west angle.

The bridge over the Euripus is of ancient origin; the first one being constructed in the twenty-first year of the Peloponnesian war. When the great warrior Alexander made his celebrated expedition into Asia, the Chalcidenses fortified this bridge with a wall, gates, and towers, and enclosed a space on the Bœotian side, within their city; this was called Canethus—probably the mount of Karababa—and served as a bridge-head. When Antiochus made a campaign (B.C. 192) against the Romans it was not in existence, indeed the Euripus had been deprived of its bridge for nearly 140 years; but when P. Emilius Paulus was returning from the conquest of Macedonia (B.C. 217), the bridge was again restored, but the care of it was much neglected, and we learn that the communication in the reign of Justinian was carried on by means of occasional planks laid down by any speculative individual; but this kind of repair was of course very precarious, because, as in the present day, it is not every person that would choose to walk the plank and pay for it. The modern bridge is partly stone and partly wood; the stone part being from 60 to 70 feet long and extending from the Bœotian shore to the square castle in the middle. The wooden part is

constructed so that it may be raised at both ends to admit the vessels, and this, which is about 35 feet long, leads from the Kastro to the castle.

Our stay was limited, and therefore we were obliged to pass by some ancient excavated cisterns in the plain near Egripos, and proceed at once to the ruins of an ancient aqueduct constructed upon arches, and situated on the south of these cisterns. This aqueduct is said to be of Roman construction, and formerly supplied Chalcis with water.

As we had little time to spare, we rushed through the dirty bazaars of the place and purchased the usual stock for sea:—viz., tobacco, pipe-bowls, coffee, sugar, goat-cheese, red-herrings, and caviare. Negropont, however, is not the place for Englishmen to visit; its scenery is not equal to some parts of Greece, and inferior to that of the Mediterranean generally. It produces large quantities of corn, but its other products are wine, wool, pitch, vallonea, cotton, and turpentine.

Again the huge iron limbs of the engine turned, the funnel puffed, and we were swept away from Chalcis in the forenoon, when Nature seemed more busy and blithe than usual.

Our route was somewhat pleasant, but yet it was lonesome; after a short time we saw the ruins of Rhamnis, where Antiphon, the master of Thucydides, was born, B.C. 480, and which is said to have had its name from the medicinal plant, *Rhamnus Catharticus*, growing there, and being used in the worship of Nemesis, who was called *Rhamnasia Virgo* in consequence. It is said that there is an inscription on the spot, which states that Herodes Atticus erected a statue of one of his adopted children here, and dedicated it to the goddess Nemesis. As we did not land, we saw little of the site of Rhamnis, beyond the walls of white marble, fringed with lentisk-bushes, and other shrubs, which might, certainly, for aught we know, have marked the site of another city, temple, or temples. Our guide pointed it out as Rhamnis, and as such I describe it.

It is a sad thing to visit a doubtful spot! But it is even more so to visit one that you know has been famed in history for its hospitality, its deeds of valour, or other



associations. The mind dwells upon the many deeds of prowess, upon the sweet carols sung within those walls now prostrate, upon the brave men who once defended its courts, now deserted, ruined, and dark. You muse, and involuntarily ask yourself—

“Where is the harp, by rapture strung,  
To melting song, or martial story?  
Where are the lays the minstrel sung,  
To loveliness, or glory?”

From Rhamnis we coasted to Marathon, and having anchored close to the shore, we went on shore to see what Byron terms the Persian's Grave, and many writers the Tomb of the Plateans. Much controversy has arisen about the small hillock, that stands in the plain; some asserting that it is the tomb of the Persians, others of the Plateans, and others of the Athenians. For my own part I think that it is that of the Athenians, because it does not seem possible that the victors should raise a monument to the memory of their enemies; and it is well known that Miltiades, who commanded 10,000 Athenians, and 1,000 Plateans, overcame the Persian army of 100,000 foot, and 10,000 horse (B.C. 490). Another reason why this heap, this trophy, may be considered to be erected over the slain of the Athenians, is because they are known to have raised several small columns upon this very plain, and that these columns were inscribed with the names of the fallen Athenian heroes.

Two thousand three hundred and thirty-five years before our party visited the plain of Marathon, the Persians disembarked their forces, which were so soon to be routed. Proudly and confidently they landed upon that shore, and crestfallen some few returned to tell of their defeat. History relates the occurrence, and the researches of antiquaries in the marsh near the sea-shore, confirms the defeat of some party, for fragments of ancient armour, coins, and lance-heads, are frequently found by those who feel disposed to dig for such relics.

The walk to the monument, barrow, or tomb, was not very interesting, and I cannot say that I felt very enthusiastic when the clayey damp mound was reached. Of course I ascended with the others this lump of earth, which is about twenty-five high, with three miserable bushes growing upon

it, and certainly cannot inspire many with any very poetical feelings. Bravery, independence, and thoughts of all such things, will crowd upon the mind, and you cannot forget all that has been well whipped into you at school; in fact, certain little incidents connected with the battle of Marathon, will force themselves upon the mind, but then stern reality, stupid matter-of-fact things, will jump up to make you think again, and then of course all your poetical ideas are swallowed up in dirty, soft clay, drizzling rain, miserable shrubs, and a few tumbles down the mound raised over the fallen warriors.

The plain of Marathon, where the famous battle was fought, is about six miles long, and one and a half-mile in breadth. It communicates with Attica by five passes, and presents a fine level bordered by the bay.

\* \* \* \* \*

Some colonists from Epidaurus settled upon an island, which was afterwards known as Ægina, or Egina, and which has also been called Ænore, Ænopia, and Myrnodonia. These people were industrious and enterprising, consequently they soon became independent, and having shaken off the support of their parent country, became one of the first states of Greece. When the battles of Artemisium and Salamis were fought, they furnished eighteen ships to sustain the former, and thirty ships for the latter. From these and many other causes, they became celebrated for their maritime, and even military skill, for they also furnished five hundred men for the battle of Plataea.

Prosperity, even in states, frequently excites envy, and, therefore, the Æginetans could scarcely expect to escape. The Athenians became jealous of the power of the islanders, and, having warred against them, they took seventy of their ships, B.C. 430, and expelled the Æginetans, who settled in Peloponessus, and returned to their island, B.C. 404, when Lysander terminated the war. Ægina's sun had nearly set, she never rose to the same position she formerly occupied, and so great was the change, that her vicissitudes became proverbial, and we find one of Cicero's friends, Sulpicius, quoting her as an example of fallen greatness and the changes affected by time.

The name of Ægina is so linked with many important historical associations, that it is almost impossible to name the one without remembering the others. Battles by sea and land, the names of philosophers, statesmen, and others crowd upon the memory at the sound of Ægina. It was upon this island that the celebrated physician, Paulus Ægineta, was born, and flourished about the year 620; he was the first who noticed the cathartic quality of rhubarb.

We are told that Ægina was celebrated in former days for the number, beauty, and richness of its monuments, but little is to be seen of them now, and that little does not confirm the assertion. A few miserable tombs, some broken mosaic pavement, which does not appear by its remains to have been of the first class, a Doric column near the sea-shore, and the ruins of the celebrated temple of Jupiter Panhellenius, where Messrs. Foster and Cockerell, with some Germans, discovered the marbles known as the Ægina marbles, which are preserved at Munich, and casts of which may be seen at Liverpool, alone testify to its former existence.

The climate of the island is said to be delightful, and the air most pure, the epidemic fevers of the Morea being almost unknown there.

The present town is built near the sea-shore, upon the site of the old city, whose ancient mole and fort may now be seen, under water, towards the south.

The contractor of beef, &c., for the British men-of-war, had a house in the island. He is a Greek, and was most useful during the late war in supplying the ships with provisions. As the spot where he resided commanded a fine view of the peak of Ægina, and also showed the peculiar style of buildings, I took the sketch from which the engraving at the head of this chapter is executed, and where a female figure, in the singular costume of the island, may be seen.

The soil has become very productive by industry and care, but it was originally very barren; however, the good crops of corn, figs, and almonds, testify that the inhabitants are by no means lazy.

Sportsmen may obtain some amusement by shooting the wild doves and pigeons which abound here, and catching some of

the fish that play around its rock-protected coast.

From Ægina we proceeded to Napoli di Romania, and anchored opposite to the village of Myli, where Demetrius Ypsilanti, with six hundred men, defeated the Egyptian army, consisting of more than double that number.

Nearly opposite to where we lay, was a small island with a ruined castle upon it, which although formerly used as a means of defence, is now converted into a prison, and towering above it in the background was the Palamede, a fortress that has been called the Gibraltar of Greece; lower still, might be seen the shipping and the town, which was once a well populated and a flourishing place, but has decreased in commerce and importance since the King of Bavaria decided upon making Athens the modern capital of Greece.

There are few spots upon the coasts of Attica that present such a picturesque appearance as Napoli di Romania, when viewed from the sea, or from the ruins of Tiryns, which are about two miles from Napoli, on the main road to Argos. The beautiful tints upon the great chain of mountains surrounding the plain of Argos, the rugged cliffs overhanging the sea, the disposition of the buildings in the town, the plain itself, and the shipping collected in the roadstead, all contribute to make the view both interesting and beautiful.

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To wander amid thy once loved hills, and groves, and temples, Attica is indeed a treat, such as few can hope to experience; yet such has been my lot. Thy shrines are desecrated, thy poets only live in history, and Greece is now degraded in the scale of nations. Yet a time may come, when olden glories will be resuscitated, and the classic land, so renowned in the annals of history, may be recreated in power. -

“Yet to the remnants of thy splendour past,  
Shall pilgrims, pensive, but unwearied,  
throng;  
Long shall the voyager, with the Ionian blast,  
Hail the bright clime of battle and of song;  
Long shall thine annals and immortal tongue  
Fill with thy fame the youth of many a shore,  
Boast of the aged, lesson of the young,  
Which sages venerate, and bards adore,  
As Pallas and the Muse unveil their awful  
lore.”



# EFFECTS OF GUNPOWDER, FIRE-ARMS, AND THE ARTS, IN CHANGING THE CHARACTER OF WAR.

GUNPOWDER and fire-arms have changed the whole character and operations of war. The precise time when they were invented does not appear to be known with certainty. Gunpowder was in use in some parts of Europe in the latter part of the thirteenth century; cannon were invented and in use soon after, between the years 1313 and 1350; though small arms were unknown until nearly two centuries afterwards, and were first used by the Spainards about the year 1521. The use of cannon alone, without small arms, enabled Cortez, with a little handful of soldiers, to conquer the natives of Mexico, the most civilized and powerful of all the nations then on the western continent.

In ancient days, when men fought with spears, javelins, and other weapons wielded by hand, very little science was necessary to command and marshal an army in the field of battle; but great physical strength, experience, skill and bravery, in the rank and file of the army, were necessary to ensure success. Maximin, an ignorant Thracian peasant, without any knowledge of science of any kind, but a giant in size and strength (being about eight feet high), by reason of his great strength, activity, and valour, gained the confidence of the Roman Emperor, Severus, and of the army; was raised to the highest military command; was an efficient general; and was finally, in the year A.D. 235, proclaimed by the army, Emperor of the Roman world. His acquirements would fit him for only the lowest grade of military command at the present age of the world; and he influenced his army in battle more by his personal example in attacking the enemy furiously, and slaying them with his own powerful arm, than by any great efforts of mind, or exercise of military science in conducting or marshalling them. What a wonderful contrast between him and Nopoleon Bonaparte as military commanders! The former used physical power, and the force of example to influence his men, and was unfit for a commander in modern times; the latter, by his mighty intellect, and accurate military science, directed all the movements

of his men with as much precision as an architect can plan and frame a building, and, when not overwhelmed with superior numbers, he conducted them to certain victory.

In ancient warfare, the party on the defensive could not gain much advantage over his antagonist by choosing his ground, and attacking his enemy from hills and heights, and from behind breastworks, trees, fences, buildings, or cotton-bags; but when they fought hand to hand both parties were nearly on an equality, so far as situation was concerned, and everything depended on physical strength, skill, experience, and personal bravery. In modern warfare, with the use of fire-arms and heavy ordnance, the party on the defensive, having an opportunity to fortify heights, hill-sides, and the mouths of rivers and harbours, and to throw up breastworks to shelter themselves from the enemy's fire, can select their ground, occupy narrow passes, defiles, and commanding positions, and have great advantage over their assailants, which they did not, and could not possess, when men fought hand to hand, with swords, pikes, battle-axes, javelins, arrows, &c. Much also now depends on fleets and vessels, not only as powerful movable engines to assail the enemy, but also to transport troops, provisions, arms, and munitions of war, to act in concert with, aid, and support land forces. All the operations of war are now very complicated and expensive, depend mostly on mechanical power, require vast expenditures on the part of the Government, and great science, experience, and ability, in the commanding-officer, and in all the superior officers; but no very great skill, experience, or extraordinary physical power, on the part of the rank and file of the army is necessary. In ancient times it required as many years as it apparently now does months to make an efficient soldier. All the operations of ancient warfare, on the contrary, were simple; and veteran troops engaged in an offensive war, maintained themselves mostly by booty, contributions levied on, and plunder taken from the enemy. Hannibal, the Carthaginian general, maintained his army in the Roman territories seventeen years, without any aid from Carthage, during nearly all the time; this cannot be done in modern times. Na-

pooleon attempted it, and thereby excited the hatred and indignation against him of nearly all Europe, and finally failed in the attempt. The military power of a nation in these days, depends more on their wealth and power to equip fleets, and to support fleets and armies, than on the number of its citizens capable of bearing arms.

In ancient times, war was waged entirely by muscular power, but at present mostly by mechanical power. It formerly required great physical strength, long experience and skill, in the soldiery, now it depends much more on the science and ability of the officers. It was formerly maintained by plunder, but now by money; formerly, when men fought hand to hand, situation gave little advantage to assail the enemy, and the aggressor had nearly equal advantages with the defender, to assail his antagonists; but now, the use of fire-arms gives the party on the defensive a great advantage over his antagonist. Offensive warfare is now much more difficult, hazardous, and expensive, than in ancient times, and defensive warfare much less so.

As the success of war formerly depended on muscular strength, skill, and experience in war, qualities which savages and barbarians usually possess, the barbarians of northern Europe were enabled to overrun and overturn the western Roman empire, in the fifth century; and the hordes of barbarian tartars have frequently conquered the more civilized nations of southern Asia; but the history of the last century shows the influence of the mechanic arts, of machinery, productive industry and wealth, as well as the use of gunpowder and fire-arms, upon war,—and furnishes evidence that civilized nations can never be again conquered by savages or barbarians.

As mechanical power is now chiefly used in war as a substitute for muscular power, and wealth and productive industry are necessary to supply it, great monied capitalists have, for half a century past, exerted more influence upon questions of war and peace, than great military chieftains; and the peaceful farmer, mechanic, and artizan, and the lords of the spindle and loom, have more influence upon the power, as well as over the destinies of

nations, than Prætorian guards and standing armies.

Gunpowder is also of great practical utility, and has produced very important results as a mechanical power, in aiding man to blast rocks, and work in quarries of stone, mines, etc. Its benefits in these particulars cannot be easily calculated. Without its aid, the progress of man in cutting canals, mill-races, and railroads through ledges of rocks and solid stone, and working in stone quarries, and mining operations, would not, probably, be more than one-tenth part as great as it is at present.

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“TELESCOPED, BY JINGO!”—A cunning butcher one morning took a ticket at the Derby railway station, for a trip to Birmingham. He was about to seat himself in the train, when he was accosted by one of the officers as to a dog he had with him, for which it appeared he had not paid the usual fare. The butcher stoutly refused to pay what was demanded; and after the exchange of sundry words between the disputants, the animal was “taken in charge,” much to the chagrin of its owner. In a brief interval, the dog either escaped, or was released, and scampered along the platform towards the place where it had been separated from its master, who, during a trifling delay of the train, had just time to secure the animal ere the whistle blew and the carriages were in motion: this circumstance, however, did not escape observation, as appears in the sequel. The traveller patted his dog, in the exuberance of his delight at having “done the railway chaps for once;” and then, turning to a fellow-passenger, and casting an incredulous, half-contemptuous glance at the magic wires along the line, confidently exclaimed, “They may telescope me now, if they CAN!” Onward sped the train; Birmingham was at length reached; but the man of economy had not walked many paces from the carriage in which he had been seated, before he was interrupted by a sudden tap, followed by—“You’ve not paid for that dog!” The butcher stared at the officer, then at his dog, and paid the money, growling out, “Telescoped, by jingo!”



# POPULAR ASTRONOMY.

## LETTER XIX.—(continued.)

VARIABLE STARS are those which undergo a periodical change of brightness. One of the most remarkable is the star *Mira*, in the Whale (*Omicron Ceti*). It appears once in eleven months, remains at its greatest brightness about a fortnight, being then, on some occasions, equal to a star of the second magnitude. It then decreases about three months, until it becomes completely invisible, and remains so about five months, when it again becomes visible, and continues increasing during the remaining three months of its period.

Another very remarkable variable star is *Algol* (*Beta Persei*). It is usually visible as a star of the second magnitude, and continues such for two days and fourteen hours, when it suddenly begins to diminish in splendour, and in about three and a half hours is reduced to the fourth magnitude. It then begins again to increase, and in three and a half hours more is restored to its usual brightness, going through all its changes in less than three days. This remarkable law of variation appears strongly to suggest the revolution round it of some opaque body,—which, when interposed between us and *Algol*, cuts off a large portion of its light. "It is," says Sir J. Herschel, "an indication of a high degree of activity in regions where, but for such evidences, we might conclude all lifeless. Our sun requires almost nine times this period to perform a revolution on its axis. On the other hand, the periodic time of an opaque revolving body, sufficiently large, which would produce a similar temporary obscuration of the sun, seen from a fixed star, would be less than fourteen hours." The duration of these periods is extremely various. While that of *Beta Persei*, above mentioned, is less than three days, others are more than a year; and others, many years.

TEMPORARY STARS are new stars, which have appeared suddenly in the firmament, and, after a certain interval, as suddenly disappeared and returned no more. It was the appearance of a new star of this kind, one hundred and twenty-five years before the Christian era, that prompted Hipparchus to draw up a catalogue of the stars, the first on record. Such, also, was the star which suddenly shone out, A.D. 389, in the Eagle, as bright as Venus, and, after remaining three weeks, disappeared entirely. At other periods, at distant intervals, similar phenomena have presented themselves. Thus the appearance of a star in 1572 was so sudden, that Tycho Brahe, returning home one day, was surprised to find a collection of country people gazing at a star, which he was sure did not exist half an hour before. It was then as bright as Sirius, and continued to increase until it surpassed Jupiter when brightest, and was visible at mid-day. In a month it began to diminish; and, in three months afterwards, it had entirely disappeared. It has been supposed by some that, in a few instances, the same star has returned, constituting one of the periodical or variable stars of a long period. Moreover on a careful re-examination of the heavens, and a comparison of catalogues, many stars are now discovered to be missing.

DOUBLE STARS are those which appear single to the naked eye, but are resolved into two by the telescope; or, if not visible to the naked eye, are seen in the telescope so close together as to be recognized as objects of this class. Sometimes, three or more stars are found in this near connection, constituting triple, or multiple stars. Castor, for example, when seen by the naked eye, appears as a single star, but in a telescope even of moderate powers, it is resolved into two stars, of between the third and fourth magnitudes, within five seconds of each other. These two stars are nearly of equal size; but more commonly one is exceedingly small in comparison with the other, resembling a satellite near its primary, although in distance, in light, and in other characteristics, each has all the attributes of a star, and the combination, therefore, cannot be that of a planet with a satellite. In most instances, also, the distance between these objects is much less than five seconds; and, in many cases, it is less than

one second. The extreme closeness, together with the exceeding minuteness of most of the double stars, requires the best telescopes united with the most acute powers of observation. Indeed, certain of these objects are regarded as the severest tests both of the excellence of the instruments and of the skill of the observer. The diagram below represents four double stars, as seen with appropriate magnifiers.

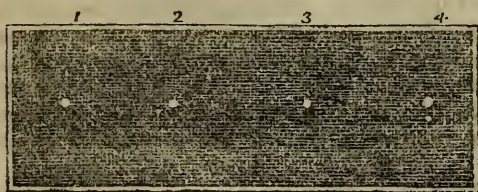


Fig. 67.

No. 1, exhibits Epsilon Bootis with a power of three hundred and fifty; No. 2, Rigel, with a power of one hundred and thirty; No. 3, the Pole-star, with a power of one hundred; and No. 4, Castor, with a power of three hundred. Our knowledge of the double stars almost commenced with Sir William Herschel, about the year 1780. At the time he began his search for them, he was acquainted with only *four*. Within five

years he discovered nearly *seven hundred* double stars, and during his life, he observed no less than *twenty-four hundred*. In his "Memoirs," published in the "Philosophical Transactions," he gave most accurate measurements of the distances between the two stars, and of the angle which a line joining the two formed with a circle parallel to the equator. These data would enable him, or at least posterity, to judge whether these minute bodies ever change their position with respect to each other. Since 1821, these researches have been prosecuted with great zeal and industry, by Sir James South and Sir John Herschel; while Professor Struve, of Dorpat, with the celebrated telescope of Fraunhofer, has published, from his own observations, a catalogue of three thousand double stars, the determination of which involved the distinct and most minute inspection of at least one hundred and twenty thousand stars. Sir John Herschel, in his recent survey of the southern hemisphere, is said to have added to the catalogue of double stars nearly three thousand more.

Two circumstances add a high degree of interest to the phenomena of double stars: the first is, that a few of them, at least, are found to have a revolution around each other; the second, that they are supposed to afford the means of ascertaining the parallax of the fixed stars.

In 1803, Sir William Herschel first determined and announced to the world, that there exist among the stars separate systems, composed of two stars revolving about each other in regular orbits. These he denominated *binary stars*, to distinguish them from other double stars where no such motion is detected, and whose proximity to each other may possibly arise from casual juxtaposition, or from one being in the range of the other. Between fifty and sixty instances of changes, to a greater or less amount, of the relative positions of double stars, are mentioned by Sir William Herschel; and a few of them had changed their places so much, within twenty-five years, and in such order, as to lead him to the conclusion that they performed revolutions, one around the other, in regular orbits. These conclusions have been fully confirmed by later observers; so that it is now considered as fully established, that there exist among the fixed stars binary systems, in which two stars perform to each other the office of sun and planet; and that the periods of revolution of more than one such pair have been ascertained with some degree of exactness. Immersions and emersions of stars behind each other have been observed, and real motions among them detected, rapid enough to become sensible and measurable in very short intervals of time. The periods of the double stars are very various, ranging, in the case of those already ascertained, from forty-three years to one thousand. Their orbits are very small ellipses, only a few seconds in the longest direction, and more eccentric than those of the planets. A double star in the Northern Crown (*Eta Coronæ*) has made a complete revolution since its first discovery, and is now far advanced in its second period; while a star in the Lion (*Gamma Lemis*) requires twelve hundred years to complete its circuit.

You may not at once see the reason why these revolutions of one member of a



double star around the other, should be deemed facts of such extraordinary interest ; to you they may appear in the light of astronomical curiosities. But remark, that the revolutions of the binary stars have assured us of this most interesting fact, that *the law of gravitation extends to the fixed stars*. Before these discoveries, we could not decide, except by a feeble analogy, that this law transcended the bounds of the solar system. Indeed, our belief of the fact rested more upon our idea of unity of design in the works of the Creator, than upon any certain proof ; but the revolution of one star around another, in obedience to forces which are proved to be similar to those which govern the solar system, establishes the grand conclusion, that the law of gravitation is truly the law of the material universe. "We have the same evidence," says Sir John Herschel, "of the revolutions of the binary stars about each other, that we have of those of Saturn and Uranus about the sun ; and the correspondence between their calculated and observed places, in such elongated ellipses, must be admitted to carry with it a proof of the prevalence of the Newtonian law of gravity in their systems, of the very same nature and cogency as that of the calculated and observed places of comets round the centre of our own system. But it is not with the revolution of bodies of a cometary or planetary nature round a solar centre, that we are now concerned ; it is with that of sun around sun, each, perhaps, accompanied with its train of planets and other satellites, closely shrouded from our view by the splendour of their respective suns, and crowded into a space, bearing hardly a greater proportion to the enormous interval which separates them, than the distances of the satellites of our planets from their primaries bear to their distances from the sun itself."

Many of the double stars are of different colours ; and Sir John Herschel is of the opinion that there exist in nature suns of different colours. "It may," says he, "be easier suggested in words, than conceived in imagination, what variety of illumination two suns, a red and a green, or a yellow and a blue one, must afford to a planet circulating about either ; and what charming contrasts and 'grateful vicissitudes' a red and a green day, for instance, alternating with a white one and with darkness, might arise from the presence or absence of one or other, or both, above the horizon. Insulated stars of a red colour, almost as deep as that of blood, occur in many parts of the heavens ; but no green or blue star, of any decided hue, has ever been noticed unassociated with a companion brighter than itself."

Beside these revolutions of the binary stars, *some of the fixed-stars appear to have a real motion in space*. There are several *apparent* changes of place among the stars, arising from *real* changes in the earth, which, as we are not conscious of them, we refer to the stars, but there are other motions among the stars which cannot result from any changes in the earth, but must arise from changes in the stars themselves. Such motions are called the *proper motions* of the stars. Nearly two thousand years ago, Hipparchus and Ptolemy made the most accurate determinations in their power of the relative situations of the stars, and their observations have been transmitted to us in Ptolemy's "Almagest ;" from which it appears that the stars retain at least *very nearly* the same places now as they did at that period. Still, the more accurate methods of modern astronomers have brought to light minute changes in the places of certain stars, which force upon us the conclusion, *either that our solar system causes an apparent displacement of certain stars, by a motion of its own in space, or that they have themselves a proper motion*. Possibly, indeed, both these causes may operate.

If the sun, and of course the earth which accompanies him, is actually in motion, the fact may become manifest from the apparent approach of the stars in the region which he is leaving, and the recession of those which lie in the part of the heavens towards which he is travelling. Were two groves of trees situated on a plain at some distance apart, and we should go from one to the other, the trees before us would gradually appear further and further asunder, while those we left behind would appear to approach each other. Some years since, Sir William Herschel supposed he had detected changes of this kind among two sets of stars in opposite points of the heavens, and announced that the solar system was in motion towards a point in the constellation Hercules ; but other astronomers have not found the changes in question such as

would correspond to this motion, or to any motion of the sun; and, while it is a matter of general belief that the sun has a motion in space, the fact is not considered as yet entirely proved.

In most cases, where a proper motion in certain stars has been suspected, its annual amount has been so small, that many years are required to assure us, that the effect is not owing to some other cause than a real progressive motion in the stars themselves; but in a few instances the fact is too obvious to admit of any doubt. Thus, the two stars, 61 Cygni, which are nearly equal, have remained constantly at the same or nearly at the same distance of fifteen seconds, for at least fifty years past. Meanwhile, they have shifted their local situation in the heavens four minutes twenty-three seconds, the annual proper motion of each star being five seconds and three tenths, by which quantity this system is every year carried along in some unknown path, by a motion which for many centuries, must be regarded as uniform and rectilinear. A greater proportion of the double stars than of any other indicate proper motions, especially the binary stars, or those which have a revolution around each other. Among stars not double, and no way differing from the rest in any other obvious particular, a star in the constellation Cassiopeia (*Mu Cassiopeiae*) has the greatest proper motion of any yet ascertained, amounting to nearly four seconds annually.

You have doubtless heard much respecting the "immeasurable distances" of the fixed stars, and will desire to learn what is known to astronomers respecting this interesting subject.

We cannot ascertain the actual distance of any of the fixed stars, but we can certainly determine that the nearest star is more than twenty millions of millions of miles from the earth (20,000,000,000,000). For all measurements relating to the distances of the *sun and planets*, the radius of the earth furnishes the base line. The length of this line being known, and the horizontal parallax of the sun or any planet, we have the means of calculating the distance of the body from us, by methods explained in a previous Letter. But any star, viewed from the opposite sides of the earth, would appear from both stations to occupy precisely the same situation in the celestial sphere, and of course it would exhibit no horizontal parallax. But astronomers have endeavoured to find a parallax in some of the fixed stars, by taking the *diameter of the earth's orbit* as a base line. Yet even a change of position amounting to one hundred and ninety millions of miles proved, until very recently, insufficient to alter the place of a single star, so far as to be capable of detection by very refined observations; from which it was concluded that the stars have not even any *annual parallax*; that is, the angle subtended by the semidiameter of the earth's orbit, at the nearest fixed star, is insensible. The errors to which instrumental measurements are subject, arising from the defects of instruments themselves, from refraction, and from various other sources of inaccuracy, are such, that the angular determinations of arcs of the heavens cannot be relied on to less than one second, and therefore cannot be appreciated by direct measurement. It follows, that, when viewed from the nearest star, the diameter of the earth's orbit would be insensible; the spider-line of the telescope would more than cover it. Taking, however, the annual parallax of a fixed star at one second, it can be demonstrated, that the distance of the nearest fixed star *must exceed*  $95000000 \times 200000 = 190000000 \times 100000$ , or one hundred thousand times one hundred and ninety millions of miles. Of a distance so vast we can form no adequate conceptions, and even seek to measure it only by the time that light (which moves more than one hundred and ninety-two thousand miles per second, and passes from the sun to the earth in eight minutes and seven seconds) would take to traverse it, which is found to be more than three and a half years.

If these conclusions are drawn with respect to the largest of the fixed stars, which we suppose to be vastly nearer to us than those of the smallest magnitude, the idea of distance swells upon us when we attempt to estimate the remoteness of the latter. As it is uncertain, however, whether the difference in the apparent magnitudes of the stars is owing to a real difference, or merely to their being at various distances from the eye, more or less uncertainty must attend all efforts to determine the relative distances of



the stars; but astronomers generally believe, that the lower orders of stars are vastly more distant from us than the higher. Of some stars it is said, that thousands of years would be required for their light to travel down to us.

I have said that the stars have always been held, until recently, to have no annual parallax; yet it may be observed that astronomers were not exactly agreed on this point. Dr. Brinkley, a late eminent Irish astronomer, supposed that he had detected an annual parallax in Alpha Lyræ, amounting to one second and thirteen hundredths, and in Alpha Aquilæ, of one second and forty-two hundredths. These results were controverted by Mr. Pond, of the Royal Observatory of Greenwich; and Mr. Struve, of Dorpat, has shown that, in a number of cases, the supposed parallax is in a direction opposite to that which would arise from the motion of the earth. Hence it is considered doubtful whether, in all cases of an apparent parallax, the effect is not wholly due to errors of observation.

But as if nothing was to be hidden from our times, the long sought for parallax among the fixed stars has at length been found, and consequently the distance of some of these bodies, at least, is no longer veiled in mystery. In the year 1838, Professor Bessel, of Königsberg, announced the discovery of a parallax in one of the stars of the Swan (61, *Cygni*), amounting to about *one third of a second*. This seems, indeed, so small an angle, that we might have reason to suspect the reality of the determination; but the most competent judges who have thoroughly examined the process by which the discovery was made, assent to its validity. What, then, do astronomers understand, when they say that a parallax has been discovered in one of the fixed stars, amounting to one third of a second? They mean that the star in question apparently shifts its place in the heavens to that amount, when viewed at opposite extremities of the earth's orbit, namely, at points in space distant from each other one hundred and ninety millions of miles. On calculating the distance of the star from us from these data, it is found to be six hundred and fifty-seven thousand seven hundred times ninety-five millions of miles,—a distance which it would take light more than ten years to traverse.

Indirect methods have been proposed for ascertaining the parallax of the fixed stars, by means of observations on the *double stars*. If the two stars composing a double star are at different distances from us, parallax would affect them unequally, and change their relative positions with respect to each other; and since the ordinary sources of error arising from the imperfection of instruments, from precession, and from refraction, would be avoided (as they would affect both objects alike, and therefore would not disturb their relative positions), measurements taken with the micrometer of changes much less than one second may be relied on. Sir John Herschel proposed a method, by which changes may be determined that amount to only one fortieth of a second.

The immense distance of the fixed stars is inferred also from the fact, that the largest telescopes do not increase their apparent magnitude. They are still points, when viewed with glasses that magnify five thousand times.

With respect to the NATURE OF THE STARS, it would seem fruitless to inquire into the nature of bodies so distant, and which reveal themselves to us only as shining points in space. Still, there are a few very satisfactory inferences that can be made out respecting them. First, *the fixed stars are bodies greater than our earth*. If this were not the case, they would not be visible at such an immense distance. Dr. Wollaston, a distinguished English philosopher, attempted to estimate the magnitudes of certain of the fixed stars from the light which they afford. By means of an accurate photometer (an instrument for measuring the relative intensities of light), he compared the light of Sirius with that of the sun. He next inquired how far the sun must be removed from us, in order to appear no brighter than Sirius. He found the distance to be one hundred and forty-one thousand times its present distance. But Sirius is more than two hundred thousand times as far off as the sun; hence he inferred that, upon the lowest computation, it must actually give out twice as much light as the sun; or that, in point of splendour, Sirius must be at least equal to two suns. Indeed, he

has rendered it probable, that its light is equal to that of fourteen suns. There is reason, however, to believe that the stars are actually of various magnitudes, and that their apparent difference is not owing merely to their different distances. Bessel estimates the quantity of matter in the two members of a double star in the Swan, as less than half that of the sun.

Secondly, *the fixed stars are suns.* We have already seen that they are large bodies; that they are immensely further off than the furthest planet; that they shine by their own light; in short, that their appearance is, in all respects, the same as the sun would exhibit if removed to the region of the stars. Hence we infer that they are bodies of the same kind with the sun. We are justified, therefore, by a sound analogy, in concluding that the stars were made for the same end as the sun, namely, as the centres of attraction to other planetary worlds, to which they severally dispense light and heat. Although the starry heavens present, in a clear night, a spectacle of unrivalled grandeur and beauty, yet it must be admitted that the chief purpose of the stars could not have been to adorn the night, since by far the greater part of them are invisible to the naked eye; nor as landmarks to the navigator, for only a very small proportion of them are adapted to this purpose; nor, finally, to influence the earth by their attractions, since their distance renders such an effect entirely insensible. If they are suns, and if they exert no important agencies upon our world, but are bodies evidently adapted to the same purpose as our sun, then it is as rational to suppose that they were made to give light and heat, as that the eye was made for seeing, and the ear for hearing. It is obvious to inquire next, to what they dispense these gifts, if not to planetary worlds; and why to planetary worlds, if not for the use of percipient beings? We are thus led, almost inevitably, to the idea of a *plurality of worlds*; and the conclusion is forced upon us, that the spot which the Creator has assigned to us is but a humble province in his boundless empire.

THE END.

### ABOUT THE EYE.

For us to be able to see objects clearly and distinctly, it is necessary that the eye should be kept moist and clean.

For this purpose it is furnished with a little gland from which flows a watery fluid, which is spread over the eyes by the lid, and is afterwards swept off by it, and runs through a hole in the bone to the inner surface of the nose, where the warm air, in passing over it while breathing, evaporates it. It is remarkable no such gland can be found in the eye of the fish, as the element in which they live answers the same purpose.

If the eye had not been furnished with a liquid to wash it, and a lid to sweep it off, things would appear as they do when viewed through a dusty glass.

Along the edges of the eyelids there are a large number of little tubes or glands, from which flows an oily substance which spreads over the surface of the skin, and thus prevents the edges from becoming sore or irritated, and it also helps to keep the tears within the lid. There are also six muscles attached to the eye, which en-

able us to move it in every direction; and when we consider the different motions they are capable of giving to the eye, we cannot but admire the goodness of Him who formed them, and has saved us the trouble of turning our head every time we wish to view an object.

Although the eyes of some animals are incapable of motion, as the fly, the beetle, and several other insects, yet the Creator has shown his wisdom and goodness in furnishing their eyes with thousands of little globes, and by placing their eyes more in front of their heads.

A gentleman who has examined the eyes of a fly, says that the two eyes of a common one are composed of 8,000 little globes, through every one of which it is capable of forming an image of an object. Having prepared the eye of a fly for that purpose, he placed it before his microscope, and looked through both in the manner of a telescope, at a steeple which was 229 feet high and 750 feet distant, and he says he could plainly see, through every little hemisphere, the whole steeple inverted, or turned upside down. Wonderful indeed are the works of Omniscience!



## THE MIRROR OF NATURE.

*(Concluded from page 319.)*

AN *aéronaut*, whose bold adventures by air and water excited at the time great interest in several countries of Europe, was the Italian, Count Zambeccari. In 1783, he had sent up a balloon of considerable size in London; and afterwards had contributed much to advance the new art. When, at a later period, October, 1803, he ascended with two companions at Bologna, the balloon rose to such a height, that the *aéronauts* were well-nigh frozen, and the Count himself afterwards lost three fingers, in consequence of being frost-bitten on this occasion. From this great height, they let the balloon descend; but it came down on the Adriatic sea, where the three men were saved; but the balloon was carried by the wind to the Turkish fortress, Vihacz, where the commandant cut the supposed gift of Heaven into little pieces, and distributed them among his friends. Upon a second attempt, in August, 1804, Zambeccari rose again into the region of intense cold, and again descended upon the Adriatic. Nevertheless, his zeal for new trials suffered no abatement until in 1812, at Bologna, he perished in one of his favourite enterprises.

As to any advantages afforded by the art of sailing in the air, or any knowledge obtained by these excursions into the upper regions,—men have not advanced in sixty years much farther than they had got in the first five years after the invention of *Mongolfier*. No safe means have yet been found of controlling the movements of the balloon at pleasure, like a ship on the water. All that has been obtained is the power of rising or descending at will; and thus of passing from one current of air, unfavourable perhaps, to another and more favourable one. On the whole, the *aéronaut* is at the mercy of the wind, upon the direction and speed of which the swiftness of his travelling depends. The greatest horizontal speed, observed in a balloon, was  $17\frac{1}{2}$  German miles per hour. Such was the rate travelled by Garnerin, in company with Capt. Sowdon, in 1802, from London to Colchester. The great balloon,

sent up December 16, 1804, at Paris, fell the next day, after being up twenty-two hours, not far from Rome; the moderate speed, which it observed in passing this distance of 230 miles, crossing the high Alps, amounted to more than 10 geographical miles in an hour. At about the same rate Robertson's air-ship at Hamburg sailed. A small balloon, sent off, June 16, 1804, at Gröningen, fell after twelve hours at Halle, and had run almost five miles in an hour. Seventeen and a half miles an hour gives 110 feet in a second. Ten miles, 64 feet in a second; the eagle flies 95 feet in a second.

The rate at which well-made balloons rose perpendicularly, was in many cases estimated at 30 and even 50 feet in a second. As the eye of the *aéronaut* has no stationary object near, by which it can measure the rate of the progress made; but as it seems to him, even when he is going quickest, as if he were standing still, so the ordinary degree of speed can be reckoned only by the time taken to reach a certain terminating point of his course, which can be ascertained in ascending only by observing the barometer. When the way upward leads through the clouds, the clouds do not appear as to us below, as fixed masses, but as ragged, torn textures, hanging downwards, and falling down, as the balloon ascends. The highest point, ascertained with scientific accuracy by the barometer, to which an *aéronaut* has risen, is that which the celebrated Frenchman of science, Guy Lussac, reached in his ascent, September 16, 1804. It amounted to nearly 22,000 feet, exceeding the height of the summit of Chimborazo 2,000 feet. The observations made in regard to the gradual decrease of the density of the air, and of the law of this decrease, are, in general, the same which have been made upon very high mountains, of which we shall speak in the sequel. At present, some less general phenomena are to be noted, which many *aéronauts* have observed, when they have reached great heights.

Birds, accustomed to live only in the lower regions of the air in the neighbourhood of the earth's surface, show themselves very susceptible of the influence of the cold, rarefied air of the higher regions of the atmosphere. When taken

up, and set free at a great height, they manifest great distress, clinging with their feet to the cords or the rim of the car; or if thrown off, they fall, as if disabled, and probably continue falling, until they reach, in a lower region, that degree of density in the atmosphere in which they are accustomed to live and fly. The conversion of water into vapour, or the boiling of water, depends not merely on the degree of heat to which it is subjected, but also on the pressure of the atmosphere. The farther we descend, so much the greater is this pressure, and so much the greater must be the heat employed in order to make water boil; the higher one rises over the surface of sea and land, so much the less is the pressure of the superincumbent column of air, and so much less heat is needed to convert water into vapour, or, in other words, to make it boil. Upon the summit of Dhavalagiri, water would boil, and in boiling possess comparatively so low a degree of heat, that an egg could scarcely be boiled hard in it.

The vapour, which, especially from violent motion, escapes from the surface of the human body as perspiration, and shows itself in part in a fluid state as sweat, is occasioned by the internal warmth of the body, in a way akin to that in which the vapour rises from water, when water is made to boil. Although below, in the neighbourhood of the earth's surface, the pressure of the air upon the body is much less than at a great height; yet, in the thin cold atmosphere of mountain-tops, we fall into a profuse perspiration upon slight exertion, even when the internal warmth is so little increased, that below on the plains, scarcely a change in the usual state of the skin would be observed. Biot and Guy Lussac felt little of this annoyance, because, reclining quietly in their car, they scarcely moved, except perhaps a finger or a hand. Nevertheless, a certain feeling of oppression, connected with a shortness of breath and an acceleration of the pulse, is a necessary consequence of the rarefied state of the air; because the lungs, in the act of inhalation, take in indeed the same quantity of oxygen gas or vital air, in respect of bulk, but the amount of the same in regard to weight is less than suffices to support life in its vigour. At the same time also, in

the proportionate degree in which the external pressure is diminished, the expansion of the internal fluids is increased, so that there arises towards the surface of the body a swelling and a strong determination of the blood, which breaks out, like perspiration from the delicate skin of the eyelids, the nose, and the mouth. Aëronauts, who have ascended to great heights, have been found upon their return to be swollen and discoloured in their faces. Some have complained of being attacked with deafness, attended with pain; when in the higher regions of the air, they have suffered a painful feeling in the drum of the ear, as if it would break through an internal pressure; and while the sound of a loud voice, or the report of a pistol, or of fulminating powder, is much more faintly perceptible in a very rarefied air, the auditory nerves were much more strongly attacked than in lower regions. Even the impressions received by the eye at very considerable heights, are, in part, different from what one might perhaps expect. It is true, the aëronaut may easily and rapidly rise, if his balloon is well constructed, beyond the region of the thicker clouds, which are seldom more than 14,000 feet above the earth (although Guy Lussac saw clouds at a height over one and a half times as high); and although the people of the country below the aëronaut have a cloudy sky, or rain, he may enjoy perhaps unobstructed the light of the sun and the stars; but yet, at those great heights, the full clearness of the atmosphere is obscured as if by a fine streaky cloud, and when it is not so, the stars are seen with a brightness painful to the eye, as upon a blueish black ground. The appearance of the earth lying far below is, here and there, even in clear weather, dimmed as by a glassy veil.

The excursion which, shortly after the invention of the balloon, was made by the Mongolfiers over a space of fifty leagues, from Paris to Beuvry, in two hours' time, and many other similar ones, have been cast into the shade in more recent times by the ascent of the aëronaut Green, who ascended in London, and remained forty-eight hours in the air, passing over the sea and then over Holland and Belgium, until he reached Nassau, where he descended. An attempt to apply aëronautics



to public purposes was made in the wars of the French Republic. Balloons went up, in which intelligent observers were seated, who were to reconnoitre the position of the hostile army. Thus, in 1795, on the day of the battle of Fleurus, French officers ascended as high as an ordinary steeple, in order to examine the encampment of the Austrian army. The balloon used on this occasion was the same with which Robertson afterwards made an ascent at Hamburg. It was 57 feet in circumference, and of an elliptical form. The force with which the strong wintry current of air strove to tear it from its position, was so great that from thirty to forty horses were harnessed to it by means of a line, let down to the earth to hold it fast. The scouts, hovering in the air, wrote their observations on tickets, which, loaded with lead, were transmitted by a cord to the earth. In the course of the war about thirty-four balloons were employed on this service. Against one of them a battery of 17 pieces was opened at Maubege, June 13, but without effect. The use of balloons for such purposes was, however, relinquished, probably on account of the length of time required to fill them with inflammable air. For although, within the first ten years after the invention of the art of sailing in the air, such improvements were made, that, from iron filings, and diluted sulphuric acid, a sufficient quantity of gas to fill a tolerably-sized balloon could be obtained in a few hours—a matter which previously took whole days—it yet appeared that, in the rapid changes in the course of a battle, the space of several hours proved to be an hour too long.

The difficulty just mentioned the English aeronaut, Green, learned to obviate by filling his balloon with gas obtained from coal, which is procured easily, and in great abundance, and is used for gas-lighting. The so-called coal-gas is indeed somewhat (almost in the proportion of  $1\frac{1}{2}$  to 1) heavier than the hydrogen obtained from iron-filings; but it has the advantage that it escapes through the sides of the balloon with much greater difficulty, and is very much cheaper, and more speedily procured. In the cities of England, where gas-lighting is used on the largest scale, there are always considerable

supplies of gas, which Green was enabled to obtain at once.

To remove another and still greater obstacle in the way of aerial navigation, which lies in the choice of materials for the manufacture of the balloon, several things have been lately proposed which appear adapted to that end. As boats have been made out of thin metallic plates of iron, for example, it has been suggested that balloons might be made of thin copper-plates, which, of proper size, might hold such a quantity of inflammable gas, that the comparatively greater levity of the gas would suffice to elevate into the air both the weight of the balloon and the car with its contents attached to the balloon. From such a balloon the gas could not escape; but it is doubtful whether thin metallic-plates, like the more yielding material of which balloons have hitherto been made, would sustain the changes in the pressure of the air at different heights of the atmosphere, without becoming bent or perhaps rent. However, we may not doubt, that human sagacity will find means to overcome all the obstacles, which up to the present day obstruct the completeness and general utility of air-ships.

### THE EYES OF INSECTS.

NOTHING within the whole range of his investigations has more elicited the admiration of the philosopher, than the wondrous structure of the human eye. Exceedingly complex in all its arrangements, it abounds with requisite contrivances for securing, under every circumstance, distinct vision; and so complete are the several parts in themselves, and so admirably adapted to each other, that it is justly deemed the most perfect of all optical instruments.

Upon its curved and crystal front fall the rays of light from unnumbered objects, spread over a landscape miles and leagues in extent; and the luminous lines converging in the eye with unerring accuracy to the interior surface, form a faithful picture of the entire scene within the compass of a finger-nail.

Perhaps a vast city is immediately before it, with its splendid panorama of towers and turrets, spires and cupolas,

piles of massive buildings and thronged streets; while beyond, the harbour is crowded with the barks of commerce, and bays and misty isles stretch away in the dim distance; yet all these are perfectly delineated upon the retina, in their just proportions and natural colours.

But if our wonder is excited when contemplating the structure of the eye of man, and of other animals, it is still more heightened upon examining the visual organs of insects, beneath the powerful glasses of the microscope. The eyes of insects differ from those of other animated existence, chiefly in respect to *number, form, and arrangement.*

In some, as in the spider, the number varies from six to eight, possessing such a diversity in their mutual arrangement, that their relative positions have been employed by writers to designate the several species.

The scorpion has six visual organs, and the centipede twenty; but other insects, as the butterfly and the dragon-fly, are gifted with a vast number of eyes, set in a common ball, to which the name has been given of *reticulated*, or network eyes. These complex organs appear to be designed for horizontal and downward vision; while *coronet* eyes are found placed upon the front and top of the heads of insects. These latter organs appear as round, transparent, and shining points, and are supposed to be employed for upward vision; they are usually three in number, and are generally arranged in the form of a triangle.

*Reticulated Eyes.*—When the eye of a butterfly or dragon-fly is viewed through a powerful microscope, it resembles a piece of network, and presents the appearance of a honeycomb, each apparent cell being a perfect eye. The outer surface of each is bright, polished, and round, like that of the human eye, and reflects as a mirror the images of surrounding objects. What therefore is commonly termed the eye of the dragon-fly, silkworm, bee, and of other insects having similar organs of sight, is in fact a complex instrument of vision, consisting of a great number of single eyes arranged in a globular case, each capable of forming distinct images of the objects before it.

Dr. Hooke discovered no less than 7,000

single eyes in the compound eye of a horse-fly; while according to the computation of Leuwenhoeck, more than 12,000 are contained in that of the dragon-fly; and M. Puget counted in each of the reticulated organs of some butterflies which he examined, the astonishing number of 17,325 lenses, each constituting a perfect eye.

Optical artists have constructed an instrument called a *multiplying glass*, by taking a solid piece of glass, bounded on one side by a plane, on the other by a curved surface, and then grinding and polishing the latter into a number of flat faces, still preserving, however, the general curvature. When a single object, as a flower, is beheld through this instrument, its images are multiplied in proportion to the number of exposed faces, and are all symmetrically arranged together, if the faces of the glass have been cut with regularity.

Reticulated eyes operate in the same manner; and naturalists, by carefully preparing these organs, and observing objects through them with the aid of a microscope, have been surprised and delighted at the wonders that have met their view. Not only are objects multiplied, but they are also *diminished* to a surprising degree. As Puget gazed at a soldier through the eye of a flea, an army of pigmies appeared before him; and the flame of a candle flashed forth with the splendour of a thousand lamps.

When Leuwenhoeck, in like manner, directed his sight to the steeple of a church two hundred and ninety-nine feet high, and distant seven hundred and fifty feet from the place where he stood, it appeared no larger than the point of a cambric needle.

The reticulated eyes of many flies shine with the brilliancy of the finest gems, and gleam with the richest hues of light. In some the tints are red, in others green, while a third class glow with a play of colours of surpassing beauty, formed of mingled yellow, green, and purple. Some ephemeral insects are gifted with no less than four of these wonderfully complex organs, the ordinary pair being of a brown colour, while the additional pair, shining with a beautiful citron hue, rise side by side from the upper part of the head.



The form of the single lenses in reticulated eyes is not the same in every insect endowed with this curious organ; for in the compound eye of a dragon-fly and honey-bee the lenses are six-sided, while in that of a lobster they possess a square form.

In certain positions, in respect to the direction of the light, they gleam with a rich golden hue, and three parallel borders are discerned, which divide the single eyes from each other.

The eyes of the bee are described by Swammerdam as being profusely covered with hairs, which pierce through the outer covering of the eye in the same manner as the hairs of the human body penetrate through the skin.

These hairs are very numerous, bristling in thick profusion over the eye, and are supposed to perform the office of eyelashes, or eyebrows, in protecting the organ from dust, or any similar annoyances that might work it harm.

## THE THERMOMETER.

BY G. H. SCHUBERT.

A COUNTRYMAN of Alkmaar, in North Holland, Cornelius Drebbel, whose great ingenuity had previously been shown in other ways, appears to have been the first who came out before the world with a Heat-measurer, invented by him in 1638. His thermometer was simple enough, and had various defects. It consisted of a glass ball at the top of a tube, the lower and open end of the tube being placed in a vessel filled with water, coloured by a solution of nitrate of copper. At the usual temperature, the fluid rose, through the attraction of the glass, to a certain point in the tube, but when the air in the ball above expanded under an increase of heat, the fluid was pressed down; when the air in the ball was contracted by cold, the fluid mounted higher in the tube. But apart from the circumstance that the degrees of heat of the rising or falling of the fluid were very imperfectly determined, the fluid in the vessel was also exposed to the changing pressure of the atmosphere.

These defects were removed by an improvement upon the thermometer made

by the Florentine Academy del Cimento, some years after, and which came into general use in 1693. The Florentine thermometer is substantially the same now in use. It consisted of a glass tube, the upper end of which was closed and melted together, the lower end terminating in a ball. Instead of mercury, which is now employed, the Florentine thermometer contained, and still contains where it continues in use, coloured spirits of wine. In an increasing heat this fluid expands, in cold it contracts, and thus indicates both changes of temperature by rising or falling in the tube. To this improvement a professor in Padua, Renaldini, in the year 1694, added yet another. The thought occurred to him of employing the freezing and boiling points of water as the two limits, between which the rising or falling of the spirits of wine was measured by a scale of degrees. Another celebrated man of science Halley, proposed the use of mercury, or of the air enclosed in a ball, which, by its expansion acts upon the quicksilver, which is contained in a long tube terminated with a bulb.

All the inconveniences to which this and other thermometers then in use were liable, were obviated by Daniel Fahrenheit, an ingenious mechanic, born in Dantzick, and afterwards citizen of Holland. The same severe winter of 1709, which occupies such a place in the account of Duval, helped this ingenious man to the invention of a thermometrical scale, which is used by the English to this day. The cold, which at that time prevailed so long, even in countries where the influence of the vicinity of the sea tempers to a considerable degree the severity of winter, Fahrenheit learned to produce artificially. He had remarked that in a mixture of sal-ammoniac and snow in equal quantities, even in a warm room, the spirits of wine in a Florentine thermometer, sank just as low as it did in the open air in the winter of 1709. Thus a fixed point for the divisions of his thermometrical scale was found, which every one could certify with but little trouble. A second point for graduating the rising of the thermometer, tolerably certain, was still more easily to be had in Nature, because every healthy man carried it in himself. This second point is the natural

warmth (blood heat) of the human body, which is most easily discovered by placing the bulb of the thermometer under the tongue, and allowing it to remain there ten or fifteen minutes. The observations made in regard to this point upon the inhabitants of different regions and climates, have shown only a very slight difference. The Malays in Ceylon, the inhabitants of Siberia, the Hottentots in Southern Africa, and the Esquimeaux in Greenland, the wild, naked Vaidas, who inhabit the forests of the Indian peninsula, and the well-clad European in his palace, all have, with only slight variations, the same blood-heat, from a little below to a little above  $97\frac{1}{4}^{\circ}$  F.,  $29^{\circ}$  Reaumur. And if some scientific men are disposed to ascribe to the continued effect of a hot climate the power of raising the warmth of the blood a degree of the thermometer, there are others again who maintain that the Esquimeaux show a higher blood-heat than the negroes on the Gold Coast—a difference of opinion which can only be settled by subjecting to examination, not the external heat given out by the body, but the internal temperature as ascertained in the mode above mentioned. The skin of the negro, under a degree of heat insupportable to the European, feels cool, because the internal blood-heat is tempered by the increased evaporation from the surface. The skin of the Esquimeaux, and the exhalation of his breath diffuses in the enclosed space of a small room a heat, which, when several of these people are together, makes a stove unnecessary; but the blood-heat in both is scarcely perceptibly different; and even in the case of the sick in the most violent fevers, the heat of the blood rises at the highest about  $9^{\circ}$  F.,  $4^{\circ}$  Reaumur.

The great advantage possessed by mercury next to air, as a fluid for the tube of the thermometer, was justly recognised by Fahrenheit. Mercury, as an excellent conductor of heat, is vastly more susceptible to the changes of the temperature than other fluids. It is much more easily obtained in a perfectly pure state than perhaps spirits of wine, which, even when prepared with the greatest care, often contains air as well as other admixtures. A great degree of cold renders it

thick; and under the higher degrees of heat it expands inordinately. It is true, mercury freezes at a cold which is  $72^{\circ}$  F.  $31\frac{1}{2}^{\circ}$  of Reaumur below the freezing point of water, and can then no longer be used to ascertain still greater degrees of cold, but, in freezing, it does not expand to a greater bulk, like water; and in such a case also the reliance upon alcohol for the measurement of cold does not go beyond a certain degree.

With all these decisive advantages which air and mercury have, as measurers of heat, over spirits of wine, the latter found, nevertheless, a new advocate in the French philosopher, Reaumur. As the name of Americus Vespuccius has been given to the world, the glory of whose discovery belongs rather to Columbus, so is Reaumur's name given to our thermometers, although they are made according to Fahrenheit's method, and filled, like his, with mercury. The careful and exact Fahrenheit owed all his knowledge to his own observation; he was not properly a man of science, but simply a mechanic. Reaumur, on the other hand, had the reputation of learning. He took great pains, however, in determining the two extreme points of his thermometer, which required that the precise moments should be fixed, when water changes its form, the melting and boiling points. In a glass tube two feet long, with a bulb over two inches in diameter, he put spirits of wine, the strength of which had been proved by its kindling gunpowder, and which had then been diluted with a fifth part of water. This fundamental thermometer was sunk in a vessel of water, surrounded by a mixture of salt and ice. At the moment when the water in the vessel was so far cooled as to begin to freeze, the point at which the spirits of wine stood was carefully marked. The boiling point was determined by putting the thermometer in boiling water. With the greatest exactness, the alcohol in the instrument, was, in the state of expansion in which it was at the freezing point, measured off with little cups, and in this way divided into 1000 equal parts. In order that, at this low temperature, and in this slightly expanded state, it might fill the glass tube just so high as at its greater expansion at the boiling point, 80 little measures or



cup-fulls had to be added, increasing the whole quantity from 1000 to 1080. This furnished the basis of the division of Reaumur's scale into 80 equal degrees.

It was in the year 1730, that the celebrated Reaumur described the thermometer, named from him, in the most widely circulated publications of France, and immediately suggested that smaller thermometers should be made for common use, the scale of which might suffice to determine the temperature of different countries and seasons, as well as that of fluids up to the conversion of water into steam.

The degrees which Fahrenheit established and employed in his thermometers, admirable for their exactness, are less than those of Reaumur's scale. Nine degrees of Fahrenheit amount to only 4 of Reaumur;  $2\frac{1}{4}$  degrees of the former scale are equal to 1 degree of the latter. Fahrenheit's zero falls upon a degree of cold, which lies somewhat more than 14 degrees below the zero of the scale of 80 degrees; this latter, the melting point of ice, corresponds to a heat of 32 degrees of Fahrenheit. If, therefore, a degree of heat is indicated by Fahrenheit, which exceeds 32, 32 must be subtracted from it, and the remainder divided by  $2\frac{1}{4}$ , and thus the corresponding degree of Reaumur will be ascertained. Thus, for example, 77° F. correspond to 20° R., for 32 subtracted from 77 leaves 45, and this sum divided by  $2\frac{1}{4}$  gives 20; 50° F. are 8° R.; 122° F. correspond to 40° R. On the other hand, when the degrees of the F. scale are below 0°, 32 must be added and the remainder divided by  $2\frac{1}{4}$ . So it is found that 13° below 0° F. are equal to 20° R., 22° below 0° F. to 24° R. For 13° to 32 give 45, 22 to 32 give 54, and these sums divided by  $2\frac{1}{4}$  give respectively 20 and 24.

These two methods of determining degrees of heat, have maintained themselves in use, dividing their popularity in the wide domain of national customs. A third method of dividing the scale, however, has more recently won such general attention, that perhaps it will attain to exclusive empire, and come to be adopted by all European nations. It is the method of the learned Swede, *Celsius*, who divides the interval between the melting point of

ice, and the boiling point of water, into 100 parts instead of 80, so that 50° of heat on this scale correspond to 40° R. and 122° F., 4° Reaumur are equal to 5° Celsius, and 9° Fahrenheit.

The thermometer, together with the barometer, among all the inventions of science, has not only become of general use in the practical pursuits of life, it has proved man's valuable attendant through the various climes and countries of the world. To it alone we owe the knowledge we have obtained of the differences of climate in different regions and heights of the earth, the information possessed of the variations in the average heat of seasons and days; and what we are able still further to say respecting heat and its effects would greatly lack precision, if the means were not at hand to measure its power.

#### DEFECTS IN COMMON EDUCATION—MORAL, PHYSICAL, AND SCIENTIFIC TRAINING.

THE acquirement of languages (on their present imperfect and unphilosophical construction), affords, it must be admitted, comparatively little exercise for the nobler powers of the mind, and is, for the most part, but little connected with the subjects on which the attention of young persons is fixed and their curiosity excited. Yet languages are made the engrossing subject of instruction,—nay, they too often occupy almost exclusive attention. Even were we to admit the propriety of this selection, we should still question the order in which the pursuit is made. Is it consistent with utility that the chief and earliest attention should be paid to dead languages? and that other foreign languages, while postponed to these, should take precedence of our native tongue? Let us not be misunderstood. We do not wish to exclude the study of foreign languages—on the contrary, we contend that it should be open, with all appliances and means, to such as are fitted for the pursuit. We admit,—nay, we maintain, that to a thorough knowledge of the vernacular tongue, to an acquaintance with its powers and its weaknesses, its riches, and its poverty, its beauties and its defects, the study of the foreign

languages is essential; but we cannot allow that it is through their medium that we shall best acquire that practical knowledge of the vernacular tongue, that power of using it with correctness, perspicuity, force, and propriety, in the ordinary concerns of life, which is so desirable for all, but is now attained by so few, even among those denominated the educated. While an acquaintance with the dead and foreign languages is thus made the one thing needful, how slight the provision that exists for exercising the observation and judgment of the young. What is done towards cultivating the moral feelings save the propounding of vague general precepts, which are not carried home to the heart, and which the children may in all probability see broken through every day by those even who advance them?—How insufficient the means for calling into action any latent power a child may possess for the cultivation of those arts and sciences on which, from his peculiar constitution, his success in life, his respectability, and, indirectly, even his rectitude, may depend! When will he find the inducement, or even the opportunity for the pursuit of mechanics, architecture, navigation, sculpture, chemistry, mineralogy, botany, geology, or that one among a dozen other branches of knowledge for which he may have a peculiar aptitude? When will those noble powers be developed which would fit him for assisting in the administration of justice, or in the general business of government? What is done towards giving him an extended view of the principles on which honourable success may best be insured in manufactures, commerce, or agriculture, or for making him acquainted with the laws of his country, or the reasons on which those laws were based? or for introducing him to a knowledge of the general laws of political and social justice, so that he may be ready as a good subject and a good man to help in forwarding the true interests of his country and of mankind at large, and join in steering clear of those errors which have ruined nation after nation. Finally, what provision exists for the systematic development of the physical powers of the body, for bringing every nerve and muscle into vigorous action, and yet without subject-

ing the one to undue excitement or the other to excessive exertion? And what is done towards giving the young a clear insight into the causes of disease; and making him acquainted with the nature and office of the different members of that system, which, from the moment of birth to the hour of death, is affected in some degree by every motion of the body, and every sensation of the mind?—*Stow.*

### ACOUSTIC USES OF GUTTA-PERCHA.

THE conveyance of *sound* is, perhaps, the most extraordinary service which gutta-percha tubes have yet rendered.

There are two qualities required in a speaking tube; first, that it shall concentrate a large amount of sound into a small space; and secondly, that it shall not stifle the acoustic vibrations within the tube itself. Any material will answer equally well, so far as the first-named quality is concerned, for it requires simply a trumpet-shaped mouth at one end, and a very small orifice at the other; but gutta-percha possesses rare qualities in respect to the second kind of service. Whether it is the smoothness of the texture, or the peculiar kind and degree of elasticity, or the relation of the substance to heat or electricity—whatever may be the cause, a tube of gutta-percha preserves sonorous vibrations with a surprising degree of clearness and equability; and the modes in which this quality are brought into useful requisition are also very numerous.

There is, for example, the *long ear-trumpet*, with a wide orifice at one end and a small one at the other; and there is the *portable ear-trumpet*, differing from the former only in bringing the speaker and the hearer close together, by a 'French-horn' system of twisting in the tube. There is the *ear-cornet*, so small and neat, that one may be almost invisibly attached to or near each ear. There is the *paraboloid trumpet*, in which the sound is echoed from a large concave receiver before it enters the tube. There is the trumpet with a long flexible tube, or with several tubes, so that several persons round a table can communicate in turn with the



user. In short, there have been almost as many useful variations of the principle as there are variations in the social inconveniences of those who require such aid.

A different group altogether is formed by those contrivances which are intended to aid—not partially deaf persons—but those whom noise or distance would otherwise disenable from conversing together. Drivers of omnibuses now sometimes communicate with the conductors, and captains of steam-boats with the engineers, by gutta-percha tubes. But these are trifling services compared with such as the tubes render at greater distances. The “Domestic Telegraph,” as it has been called, is simply a gutta-percha tube conducted from one apartment to another: it is employed as a medium of transmitting messages, and saves many a weary footstep to those who are at the beck and call of others. The “Medical Man’s Midnight Friend” (a lackadaisical sort of title) is a gutta-percha tube extending from the “doctor’s” street-door to the doctor’s bed, by which a message can be transmitted to the awakened practitioner instead of merely the sound of his bell. In factories and large establishments such speaking tubes are advancing extensively in favour; for communication between distant buildings it is most complete. In printing-offices, spinning and weaving mills, in union poor-houses, in hospitals and infirmaries, and in various other establishments of magnitude, the advantages are so self-evident that the use is becoming very general.

The church acoustic apparatus is in many respects the most interesting and remarkable of these highly curious applications. Let us conceive, for clearness of illustration, that in a remote pew of a church is a person who, though not deaf, yet fails in ability to hear what is said in the pulpit or reading-desk. A gutta-percha tube is laid down either on or beneath the floor from the pulpit to the pew—the material bends so easily that it may be carried in any form—and a small ivory or hard wood ear-piece is attached to one end, while the other end expands in trumpet-form. Now the remarkable circumstance is, that the required effect is brought about without necessitating the approach of the speaker’s mouth to the

tube; his head may be two or three feet above, or below, or behind, or at the side of the trumpet-mouth; and yet the sound will reach the remote end of the tube in audible quantity. The truth is, that if the tube receives a *mouth-full* of sound (which it can in any direction round and near the speaker), that quantity is so economised, and so faithfully conveyed to the other end, that it becomes condensed to an audible pitch; if the trumpet-mouth be large, and the ear-piece very small, we may liken the action to the condensation of many threads of sound into one; and the ear of the auditor becomes sensible to this condensed power. In practice, the trumpet-mouth is usually fixed to the front of the pulpit, mouth uppermost, and is stamped or moulded in an ornamental form consistent with the decorations of the pulpit. Beyond all this, the sound may be *laid on*, like gas, to any pew or any quarter of the church; for there may be a tube (which we will call the main-pipe) laid along the centre aisle, and lateral tubes may spring from this to any required spot. Some clergymen have what they call a *deaf pew*; that is, a pew in which those are congregated who may be collectively benefited by this admirable apparatus. This contrivance has been used at some of the great meetings (four thousand strong) at Exeter Hall, by those to whom the speeches would otherwise have been little else than dumb show.

EARLY RISING.—Dr Wilson Phillip, in his “Treatise on Indigestion,” says:—“Although it is of consequence to the debilitated to go early to bed, there are few things more hurtful to them than remaining in it too long. Getting up an hour or two earlier often gives a degree of vigour which nothing else can procure. For those who are not much debilitated and sleep well, the best rule is to get out of bed soon after waking in the morning. This at first may appear too early, for the debilitated require more sleep than the healthy; but rising early will gradually prolong the sleep on the succeeding night, till the quantity the patient enjoys is equal to his demand for it. Lying late is not only hurtful, by the relaxation it occasions, but also by occupying that part of the day at which exercise is most beneficial.”

## EASTERN RAMBLES AND REMINISCENCES

## RAMBLE THE THIRTIETH.

VENICE, ITS APPEARANCE FROM THE SEA—PIAZZA OF ST. MARK—ITS TWO COLUMNS—A FAVOUR GRANTED AND ANNULLED—THE DUCAL PALACE, AND THE PROLOGIO—HISTORICAL ASSOCIATIONS CONNECTED WITH THE PIAZZA OF ST. MARK—THE GIANT'S STAIRS AND MARINO FALIERO—THE COUNCIL AND BALLOTING CHAMBERS, WITH THEIR PAINTINGS—HALLS OF THE PREGARDI AND COUNCIL OF THE TEN—THE LION'S MOUTH—THE PIOMBI, OR PRISONS OF VENICE—THE GRAND CANAL, ITS PALACES, BRIDGES, AND CHURCHES—PIAZZA OF ST. MARK AT NIGHT—THE ARSENAL AND ITS CURIOSITIES—THE CHURCH OF ST. MARK—ACADEMY OF ARTS, ITS TREASURES AND RELICS—FAREWELL TO VENICE—CONCLUSION.

"Venice, proud city, based upon the sea,  
A marvel of man's enterprise and power:  
Glorious even in thy ruin, who can gaze,  
On thee, and not bethink them of the past,  
When thou didst rise, as by magician's wand,  
On the blue waters like a mirror spread,  
Reflecting temples, palaces and domes,  
In many lengthen'd shadows o'er the deep?  
They who first rear'd thee, little dream'd, I  
ween,

That thou, their refuge, won from out the sea  
(When despotism drove them from the land),  
Should bend and fall by that same cold stern  
thrall,

That exiled them, here to erect a home,  
Where freedom might their children's birth-  
right be,

Wealth, and its offspring Luxury, combined,  
To work thy ruin by Corruption's means.  
How art thou fallen from thine high estate,  
The Rome of Ocean, visited like her  
By pilgrims journeying from their distant  
lands,

To view what yet remains to vouch the past,  
When thou wert glorious as the seven crown'd  
hills,

Ere yet barbarian hordes had wrought their  
doom!

Here Commerce flourish'd, pouring riches in  
With floating argosies from distant ports,  
And paying with a lavish hand for Art,  
That still lends glory, Venice, to thy walls!  
Here came the trophies of thy prowess, too,  
The steeds, Lysippus, that thy chisel wrought.

COUNTESS OF BLESSINGTON.

gold the countless palaces, steeples, domes, churches, bridges, and columns of fair Venice, looking, as Byron has described her,

"Fresh from the ocean,  
Rising with her tiara of proud towers  
At airy distance."

It is almost impossible to convey even an idea of the appearance of this extraordinary city rising out of the bosom of the waters which penetrate into the very heart of it. A feeling of surprise akin to awe steals over you, when gazing upon it for the first time,—for it seems more like a beautiful city overwhelmed by the ocean and gradually sinking from the world's gaze, than one where all that is beautiful and costly are collected, and where luxury and vice reign predominant.

On approaching Venice from the sea, I was surprised to observe lines of posts with painted tops which encircle the whole city, and are placed a few hundred feet apart; they are intended to mark the limits of the place, and serve as guides for the gondoliers.

An hour's pull from one of the lagoons formed by the deposit of several streams and the waves of the Adriatic, brought us to the foot of one of the bridges; where we landed, and were soon amid the motley throng of Italians, Turks, Greeks, and other foreigners, looking as if they were the actors in a carnival. All the bustle and stir of a vast city burst suddenly upon us; for the approach was unmarked by any hum of commerce, and so unlike that of any we had yet seen. It was like transporting a person instantly from a desert, to the heart of London or Paris.

Walking along the edge of the quay, lined with palaces and coffee-shops, and peopled by the representatives of all nations, in all costumes, we proceeded to the Hôtel d'Europe, secured beds, and ordered dinner, and then sallied forth to see the "lions" of Venice and St Mark.

Our first visit was to the Piazza of Saint Mark, which is a vast area, deserted by day and crowded by night. Behind us was the Moto, the steps of which are laved by the waters of the Adriatic, and thronged with mournful-looking gondolas, and where two granite columns tower above the surrounding buildings. The column upon our left, as we faced the

It was morning, and the sun shone with all his power and splendour, painting as with





VENETIAN WATER-CARRIERS.

church of St. Mark, was surrounded by a brass-winged lion, called the Lion of St. Mark, the ancient emblem of the Republic. The column to our right had a statue of St. Theodore, a patron Saint of the republic, placed upon its summit. A story is related of a certain nobleman having rendered an important service to the state, and as a return he was requested to ask any favour he chose, which he was promised should be immediately granted. It happened that a short time before the young noble had rendered this service, gambling was carried on to such a fearful extent that murders and robberies, with many other crimes, were of daily occurrence; and therefore a decree was issued

forbidding gambling anywhere in Venice, under the penalty of death. The young nobleman had often indulged in the ruling fashion of the day, and prompted by some of his former associates, he requested as a favour that gambling might only be permitted between the two columns upon the Moto. Of course his request was granted; and shortly afterwards the same spot was selected as the place for public executions, an expedient that speedily arrested gambling among the higher classes, and even the less wealthy. I do not vouch for the truth of the tale; it is given as related to me.

On our right was the Ducal Palace, with its balconies, galleries, monuments, and peculiar architecture; and beyond, the Church of St. Mark with its cupolas, pinnacles, and porches, surmounted by the four famous copper horses, which Cicognare regards as a Roman work of Nero's time, and close to the Church of St. Mark is the *Orologio*, or clock-tower, designed by Pietro Lombardo, 1494, with its gaudy dial, representing the sun travelling round the zodiacal signs upon its

surface. Above this tower is a large bell placed upon a pivot, and not suspended, as usual; at each side is a figure with a hammer in his hand to strike the quarters, half hours, and hours. A man is said to have been killed by one of these figures; for while he was repairing some portion of the machinery, he stooped his head in such a position that the figure struck him on the head and knocked him over the parapet, as it was about to strike the half hour upon the bell. Immediately beneath the bell is the Winged-lion of St. Mark, glittering amid a host of stars upon an azure ground; and below this compartment is a niche, with a gilt bronze statue of the Virgin.

What a host of historical associations crowd upon the mind when standing in that square, where Henry III. was received by the senate, when he passed through Venice, after leaving Poland, to ascend the throne of France! Here, underneath an awning stretched from side to side of that vast area, which was spread with the richest carpets, and fitted up with unusual magnificence, did that monarch receive the addresses of the senate. Who can tread upon the state entrance of Venice, between its two granite columns, and not think of Frederick Barbarossa, and others no less illustrious in the page of history?

We had much to see in a short time, and therefore repaired at once to the Ducal Palace, to ramble through its labyrinth of rooms, each of which has its own peculiar history. Passing through the portal, we ascended the very steps at the top of which the Doge used to be crowned in former times, and on which the unfortunate Marino Faliero\* was crowned, uncrowned, and beheaded—yes! these are the very marble stairs, now called “La Scala de Giganti, or the Giant’s Stairs,”

“Down which the grizzly head of old Faliero  
Rolled from the block.”

Faliero commenced the palace, and he was welcomed by the Republic as ruler on the very spot where he was beheaded. At the top of these stairs are two colossal

statues of Mars and Venus, by Sansovino, the artist that designed the bronze pedestals in front of the Church of St. Mark, the stately façade of the *Procuratie nuove*, and many other interesting specimens of art, in the fallen city.

As soon as we had arrived at the top of the stairs, we entered a gallery, and having passed through it, ascended a fine flight of marble steps, and then entered the Council-chamber, which contains the famous picture of the “Glory of Paradise,” painted by Tintoretto, a short time before he was gathered to his fathers. It is said to be the largest picture, in oils, in the world; and although it has been retouched by somewhat unskilful hands, it is still a gem. The walls and ceiling are ornamented with the works of Tintoretto, Francesco Barbaro, Dominico Barbaro, the son of the former; Palma, the younger; Frederico Zuccari, and Paolo Veronese.

The Council-chamber is now used as a library, and in addition to the historical paintings by the artists named above, there are some fine pieces of Grecian sculpture at one end, and some of the portraits of the doges, painted by Tintoretto, Leandro Bassano, and the younger Palma. These are ranged above the historical paintings, and in the place where that of Marino Faliero should have been is the well-known inscription, “*Hic est locus Marini Falethri, decapitati pro criminibus,*” painted upon a black ground and framed. The remaining portraits of the doges are in the Ballotting-chamber, with the exception of the last doge, Manini, who abdicated.

Having traversed this splendid room and admired its several exquisite specimens of Italian art, we proceeded to the Ballotting-chamber, the upper part of which is bordered by the portraits of the doges, and the lower part by large historical paintings by the younger Palma, and Pietro Liberi. The “Victory of the Dardanelles,” by the latter, is a splendid piece of grouping and colouring, and is generally remembered for the naked slave in the foreground. In addition to these, there is an allegorical triumphal arch, by Lazzarini, dedicated to Francisco Morosini, who conquered the Morea during his dukedom, and consequently obtained the name of the Peloponnesian.

The Hall of the Pregadi, with the sena-

\* For an interesting account of the particulars relating to his decapitation, &c., and the portrait of himself and wife, see “The Parlour Magazine of the Literature of all Nations,” vol. i., p. 70.



tors' stalls, is still an object of curiosity, not only for its associations and the preservation it is in, but also for some beautiful paintings by Marco Vecellio, the younger Palma, and Tintoretto.

In the chamber near to the chapel is Bonifazio's celebrated painting of the "Buyers and Sellers driven out of the Temple," and some gems by Tintoretto, with a fine statue of the Virgin by Sansovino. The only fresco of Titian's now in Venice is to be seen on a small staircase adjoining, the subject, which is admirably executed, is St. Christopher.

From these interesting works and scenes, we strayed to the "Hall of the Council of Ten," the ceiling of which was painted in camaïeu, by Paolo Veronese, assisted by several other artists, and which is universally pronounced to be the most magnificent in Italy. Every place is adorned with the most splendid specimens of the best Italian artists, not even excepting the ceilings and staircases. Even this dreaded chamber contains Leandro Bassano's "Return of the Doge Sebastiano Ziani," and some paintings by Marco Vecellio and Aliense, the Milanese artist.

Our guide had omitted to show us the Lion's Mouth, and therefore we retraced our steps a little, to observe that which was formerly most dreaded in Venice, and which Rogers mentions in the following lines:

"Yesternight, the proofs,

If proofs they be, were in the Lion's mouth,  
Dropt by some hand unseen."

Into this horrible post-office all the scandalmongers and ruffians of Venice dropped their notes, frequently accusing innocent persons of the most dreadful crimes. When the French ransacked the city, the Lion's Mouth was removed, but the opening beneath it remains, and appears somewhat like an ordinary London letter-box. On the other side of the wall in the Council-chamber of the Ten, is seen the place where the members of that body could become possessed of the contents of the communications.

We next visited the chamber of the Mysterious Three, the terror of Venice, unknown, unseen, and yet, most feared. It was one of this body—the hateful Lodovico—*the*—that caused the death of the two Foscari.

Leaving this chamber, we next proceeded by a staircase to the gallery leading to the Piombi, or state-prisons of Venice, and the Pozzi. The Piombi, one of a much later date than the Pozzi, which had not been used for many years before the fall of the republic. They are the upper parts of the Ducal Palace, immediately under the leads; and one of the windows is shown as that by which the Venetian Casanova escaped. When a prisoner was condemned to death, he was conducted across the gallery connected with the prisons on the other side, and led back into a cell upon the bridge:

"That fatal closet at the foot,  
Lurking for prey, which, when a victim came,  
Grew less and less, contracting to a span;  
An iron door, urged onward by a screw,  
Forcing out life."

The gallery is a covered sombre bridge, divided by a stone-wall into a passage and a cell, built high above the waters, and is called "*Ponte dei Sospiri*," or, the Bridge of Sighs, which is so admirably described by Byron in the following couplet:

"I stood in Venice, on the Bridge of Sighs,  
A palace and a prison on each hand."

The Pozzi are below the palace, and scarcely a ray of light glimmers in the narrow gallery leading to the cells, which are quite dark. A small hole in the wall admitted the damp air of the passages, and served for the food being given to the prisoners. A wooden pallet, raised about a foot above the ground, similar to those used by the Trappists, was the only furniture. The cells are about ten feet long, five feet wide, and seven feet high: the walls are very thick, and boarded to the ceiling in order to prevent humidity.

As we were passing out of the courtyard of the Ducal Palace, I observed some persons in the centre, gathered around a large stone; and approaching nearer, discovered that it was a well, and that some were drawing fresh water from below the waters of the Adriatic, while many of the others were having a gossip. The group was so picturesque, and so characteristic of Venice, that I have selected it for the heading of this chapter, from the many sketches taken during my stay. In the distance, is one of the fair Venetians with her empty buckets, approaching the group, and, on the left, is one laden with the water she has just drawn from below the

well-worn parapet of the old well. The one standing in the centre, with her right hand resting upon the metal bucket of water, is listening to the handsome young gondolier, who has drawn the water from the moss-clad well, and is now telling his tale of love, perhaps making his first appeal. These wells are to be found in most squares; and, of a summer's evening, the space around them is generally crowded with gossips, wits, lovers, and those who delight in the cool of the spot. We cannot look upon the well-worn copings of these "*Pozzi*," and not remember the alarm that spread through Venice, when she was at war with Genoa, on the report circulating far and wide that the wells had been poisoned. Around many of these wells the gondoliers have sung the stanzas of Tasso, but now,—

"In Venice, Tasso's echoes are no more."

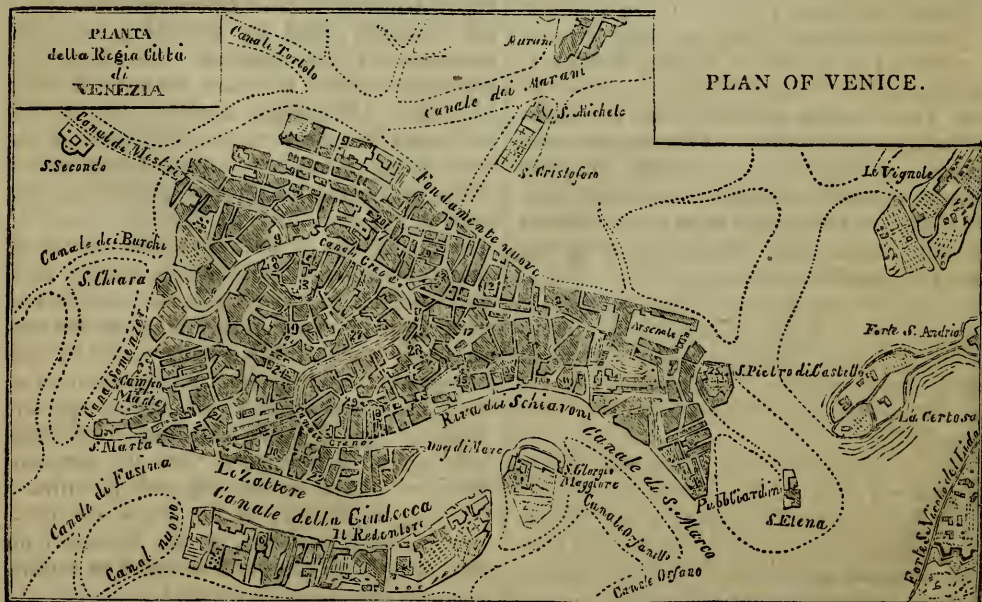
Venice, which is about eight miles in circumference, is built on a cluster of 72 islands, which rise in the middle of the Lagoons. The houses are erected upon piles, and have stone foundations; many of the palaces are built entirely of fine marble, and present a beautiful appearance when seen from a gondola, with all their glow of colouring reflected from the surface of the waters.

It has been said that Venice is like a

flat fish with its nose turned towards the main land, which is about two miles distant at the nearest point. During my stay in the "*City of the Waters*," I purchased a map of it, which is here presented on a reduced scale for the information of my readers. It will be observed that all the Italian names are preserved in the map, and this has been done because it would render the description of the city tedious, to translate the name of each church and canal.

Venice is divided by the Grand Canal, which resembles the letter S, into two portions; and in addition to this main thoroughfare, there are 149 smaller canals, crossed by 386 bridges, including the famous Rialto, which is the only bridge over the Grand Canal. There are 28,000 houses and about 2,000 streets, lanes, and alleys, for the accommodation of its 104,000 inhabitants. How is the glory of Venice departed? Before the fall of the Republic, in 1789, the population was 139,000,—and now there are nearly 40,000 of its inhabitants beggars, or depending upon the remainder for support.

Jumping into a gondola we entered the Grand Canal, which is bordered by fine marble palaces,—examples of the progress of Italian art, during the past ten centuries. Here are the palaces where once dwelt the glory and pride of Venice,—the





Foscari, Pisani, Grimani, Micheli, Contarini, Barbarigo, Manfrini, and others no less illustrious. In these ruined palaces there are many famous paintings and sculptures, particularly in the Manfrini palace. The palace of the Foscari, like many others, is in ruins.

The churches upon the Grand Canal, or near to it, are St. Geoigio Maggiore; one of Palladio's designs, which was begun in 1556, and finished in 1579, after his death. The façade is of the Composite, with the lesser Corinthian order; and the interior, which is very fine, contains some excellent paintings by Bassano ("The Nativity"), Tintoretto ("The Martyrdom of St. Stephen," "Manna in the Desert," "The Resurrection," &c.), and some fine examples of casting and sculpture. Among the former we saw four beautiful bronze statues of the Evangelists, by Campagna, supporting a globe upon which the Saviour stands. Like all the other churches abroad, its interior is a gorgeous display of paintings, sculpture, castings and relics, so mingled, and so numerous that it would require a large volume to enumerate the qualities, beauties, and virtues of each. I might particularize several of the Venetian churches, especially Santa Maria della Salute, and St. Giovanni-e-Paolo; but as I am not writing a history of each, it is better to proceed to the description of other places.

We have only to remember the number of gondolas formerly employed in Venice, to convince us that it is rapidly declining, and perhaps ere many years will be swept into the bosom of the waters of the Adriatic, with its vast treasures of art and luxury. Formerly, the number of gondolas was 6,500; in 1827, they were only 678; and in 1844, they were said to number only about 500. Byron very properly asks the question,—

"Didst ever see a gondola?—For fear

You should not, I'll describe it you exactly:

'Tis a long, cover'd boat that's common here,

Carved at the prow, built lightly but compactly;

Row'd by two rowers, each call'd 'gondolier,'

It glides along the water looking blackly,

Just like a coffin clapt in a canoe,

Where none can make out what you say or do.

And up and down the long canals they go,

And under the Rialto shoot along,

By night and day, all paces, swift or slow."

His description so exactly accords with the appearance that it is impossible to add or subtract anything from it.

On our return, the Piazza of St. Mark was all bustle, for an excellent band belonging to the Austrian regiment stationed there were performing some of Bellini's gems, and the sweet sounds of the Italian airs, and the beauties of Venice promenading, added an additional charm to the magnificent Piazza. The moon had just risen, and was shedding her silvery light upon those antique and bold-looking palaces, where so many important scenes in history's page have been enacted. Those long dark shadows flitting upon the square of St. Mark, the hum of the populace collected in that vast area, were calculated to make a deep impression upon one whose mind was stored with the many sad scenes acted in the history of Venice.

Early the next morning, we paid a visit to the Arsenal, which was formerly one of the wonders of Venice, and now only serves as a monument of its former greatness. At the gate are two colossal marble lions, brought from the Peiræus of Athens, by Morosini. They were formerly placed upon the pilasters at the entrance of the Peiræus, and, no doubt, looked well; one lion is rampant, the other couchant.

To describe the piles of arms ancient and modern, the banners and models—especially that of the *Bucefaut*, the vessel formerly used by the Doge on the occasion of his wedding the Adriatic, would be tedious to some and unprofitable to others. We might describe the armour of Henry IV., given to him by the republic, with great minuteness, and many other relics of interest to the few, but not to the many.

The Church of St. Mark was the first place we visited on the morrow, and although its architecture is Byzantine, yet its design is more grotesque than beautiful, and more richly ornamented than is necessary for the style. The interior is a mass of mosaics, floor and ceiling equally elaborate—sculptures, paintings, carvings, and relics, so mingled, that the general effect produced is dazzling and splendid.

From the Church of St. Mark we proceeded in a gondola to the Academy of Arts, where all that is beautiful in sculp-

ture and painting belonging to Venice is now collected; at least such as can be obtained. It is impossible to enumerate a title of the most beautiful paintings in the place; room after room may be traversed with delight, and yet much remains to be seen. The chisel of Canova, and the first and last painting of Titian, are among its curiosities and relics. There is scarcely an Italian artist that is not represented in this Italian National Gallery.

The time had arrived to bid adieu to Venice, that city where horses and carriages are useless, and boats supplant them; where gardens appear as little missed as in the heart of great London; where only one promenade serves for a whole city; where intrigue, robbery, and sometimes murder, are looked upon as naught, instead of *naught-y*; where all the fruit that is sold in her markets is known to be the produce of another place.

Adieu, Venice! once a bright star of the Adriatic, but now rapidly sinking into ruin and neglect. May thine end be more glorious than thine origin!

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Gentle reader, if you have kept pace with me in my rambles, I have to hope that the journey has not been tiresome. We have travelled over many lands, and encountered many hardships, but yet, with the true spirit of a guide, I have only shown you the beautiful and omitted the disagreeable. If my pictures have been too highly coloured, forgive my enthusiasm for sketching the scenes when they looked brightest, and in the words of Byron, let me conclude by asking:

“Ye, who have traced the pilgrim to the scene  
Which is his last, if in your memories dwell  
A thought which once was his, if on ye swell

A single recollection,—not in vain  
He wore his sandal-shoon and scallop-shell;

Farewell! with *him* alone may rest the pain,  
If such there were — with *you*, the moral of his  
strain.”

KAF.

## DIAMOND WORKING.


THE operations undertaken in 1852 with the far-famed Koh-i-noor illustrate in a striking degree the extreme difficulty of cutting and shaping these costly gems. Six million persons, more or less, agreed that the Koh-i-noor does not reflect light with such dazzling brilliancy as might have been expected, and since the close of the Exhibition, the most experienced mineralogists, jewellers, and diamond merchants have been consulted, to determine the question what is the cause of the alleged deficiency, and to devise a means of remedy. After much consultation, it was determined to re-grind the surface of the diamond, giving to its surface new facets which would reflect light better than the old. It seems rather startling to be told that a small steam-engine has had to be erected to aid in the grinding of a stone only an inch or so in length; but such is the case. So intensely hard is the diamond, that nothing will fairly cut it but some of its own dust, and this is placed upon a metal wheel-revolving with great rapidity—so great, indeed, as 2,000 times in a minute. The diamond was completely imbedded in a mass of solder, leaving nothing exposed but the small angle of facet which was to be operated upon; this angle was applied to the rapidly-revolving wheel, which, with the aid of the diamond-dust, gradually wore away the substance of the diamond and produced a new facet. But so numerous are the difficulties of the operation, involving, as it does, the preservation or destruction of so valuable a gem—that there were no workmen in England considered equal to the task, and two had to be brought over for this purpose from Holland, where nearly all the diamonds for European jewellers are cut. The work to be done was, to remove a flaw which Professor Tennant discovered in the Koh-i-noor, to give new and brilliant facets, and yet to grind away scarcely any of the substance of the diamond.



## THE TUTOR AND HIS PUPILS.

[APPENDIX.]

Editor's Address:—London, 69, Fleet-street. The Editor of the "Family Tutor."

 The Appendix of the FAMILY TUTOR is designed to supply information upon matters of an Educational character. Domestic matters—the legitimate theme of the FAMILY FRIEND—cannot be introduced here. Before our Pupils proceed to question us upon any subject, they should refer to the Indexes of former volumes, as it is probable, from the great number of questions answered, that the information they seek may have been already supplied. We shall be happy to include in this department suggestions from Parents and Teachers upon Educational subjects.

**1—Age of Trees.** G.—The age of a tree is determined by the number of circles which appear on the trunk or stock cut perpendicularly.

**2—Zollverein.** T. T.—This term is derived from the German *zoll*, toll or custom, and *verein* for *vereinigung*, combination; a commercial or custom's union, establishing a uniform rate of customs on the several German states joining the union.

**3—Advowson.** H. R.—This term is derived from the Latin *advocare*, or *ad* to, and *voco*, to call or appoint; a right of presentation to a church or benefice. He who possesses this right, is called the patron; when there is no patron, or he neglects to exercise his right within six months, it is called a lapse, *i. e.* a title is given to the ordinary to collate to the church.

**4—Medical Diplomas.** I. W. S.—The price of the diploma from Apothecaries'-hall is ten guineas for those who intend to practise in London, or within ten miles, and six guineas for those who intend to practise elsewhere in England; and with one or other of these diplomas, the medical aspirant may proceed to exercise his profession; but the usual course is to become members of the College of Surgeons, as well as licentiates of the Apothecaries' Company.

**5—Medals.** J. B. S. — The parts of a medal are the two sides, one of which is called the *face*, *head*, or *obverse*; the other the *reverse*. On each side is the *area*, or *field*; the *rim*, or *border*; and the *exergum*, which is beneath the ground, whereon the figures represented are placed. On the two sides are distinguished the *type*, and the *inscription* or *legend*. The type, or device, is the figure represented; the legend is the writing, especially that around the medal. What is found in the exergum consists of, generally, some initial letters, and sometimes the date of the coin.

**6—Swimming.** E.—This art considered with regard to the movements that it requires, is useful in promoting great muscular strength; but the good effects are not solely the result of the exercise that the muscles receive, but partly of the medium in which the body is moved. Both the considerable increase of general force, and the tranquillizing of the nervous system produced by swimming, arise chiefly from this, that the movements, in consequence of the cold

and dense in which they take place, occasion no loss, in relation to the result produced by increased evaporation from the pores, consequent upon violent bodily exertion.

**7—Popular Education.** T.—More has probably been written on the subject of education within the last fifty years, than during all previous time. Another fact is also worthy of notice, as significant of the change which has passed over the opinions of mankind on this subject. Formerly, when writers treated of education, they had reference only to "our noble and gentle youth," as Milton terms them; to those who were intended for the higher walks of life. This was the case with Locke, Fenelon, Ascham, and with Milton himself. It is only within the last century that we find education proper, *i. e.*, the education of the whole people, made the subject of prominent discussion.

**8—To construct an Orrery.** W. H.—To make an orrery of the dimensions mentioned by our correspondent would involve much labour and expense. A very instructive toy might be constructed by placing a taper in the centre of a japanned waiter, to represent the sun, and fixing in a watch-glass an India-rubber ball, with the parallels of latitude and meridians painted thereon, with the other characters of the globe. During its revolution around the candle, in consequence of the tendency of its centre of gravity to its lowest position, the diurnal and annual motions, and also the parallelism of its axis will be represented, together with the concomitant phenomena.

**9—Flies walking on the Ceiling.** H. L.—The power of flies, and other insects to walk on ceilings, smooth pieces of wood, and other similar surfaces, in doing which the gravity of their bodies appears to have no effect, may be explained by the following experiment, showing the effects of atmospheric pressure:—If a piece of moist leather be placed in close contact with any heavy body having a smooth surface, such as a stone or a piece of metal, it will adhere to it; and if a cord be attached to the leather, the stone or metal may be raised by it. This effect arises from the exclusion of the air between the leather and the stone. On the same principle the feet of flies, insects, &c., are provided with an apparatus exactly similar to the leather applied to the stone.

**10—Directions for taking Exercise.**—D. W.—As sudden transitions are always bad, exercise should begin gently, and should terminate in the same manner. The left hand and arm being commonly weaker than the right, they should be exercised until they become as strong. The being cooled too quickly is injurious. Therefore, drinking when very hot, or lying on the cold ground, should be carefully avoided. No exertion should be carried to excess, as that only exhausts and enfeebles the body. Therefore, whenever the gymnast feels tired, or falls behind his usual mark, he should resume his clothes and walk home. The moment exercise is finished, the clothes should always be put on, and the usual precautions adopted to prevent taking cold.

**11—Americanisms.** F. H. S.—Our correspondent wishes to know the reason why certain peculiarities of speech distinguish Americans from Englishmen. Dr. Latham gives five causes. 1. The influence of the aboriginal Indian languages. 2. Influence of the languages introduced from Europe anterior to the predominance of English; viz., French in Louisiana, Spanish in Florida, Swedish in Pennsylvania and Delaware, and Dutch in New York. 3. Influence, &c., subsequent to the predominance of the English; viz., German in Pennsylvania, and Gaelic and Welsh generally. 4. Influence of the original difference of dialect between the different portions of the English population. 5. Influence of the preponderance of the Anglo-Saxon, over the Anglo-Norman element in the American population generally.

**12—St. Swithin.** B. R.—The popular adage of forty days' rain after St. Swithin, is said to have originated from the following tradition: Swithin, who held the office of chancellor under two Anglo-Saxon kings, and was preceptor to Alfred the Great, was also Bishop of Winchester, and died in 862. He desired that he might be buried in the open churchyard, and not in the chancel of the minster, as was usual with other bishops, and his request was complied with; but the monks, on his being canonized, considering it disgraceful for the saint to lie in a public cemetery, resolved to remove the body into the choir, which was to have been done, with solemn procession, on the 15th of July. It rained, however, so violently for forty days together at this season, that the design was abandoned.

**13—Mesmeric Influences.** C. N. W.—Much has been written for and against animal magnetism, and we are unwilling to open our pages to useless discussions on the subject. Our correspondent is too hasty in condemning principles, which it is evident he does not understand. The patient labour of years is often necessary to refute error, and mere denials do not produce conviction. Every natural science, and every branch of a natural science, must at first pass through a period of darkness and error. Physics were preceded by magic,—chemistry by the art of making gold,—medicine by the elixir of life and the philosopher's stone,—astronomy by astrology, &c. First notions have always been indistinct, confused; and hence unfavourable to the marvelous, to the mysterious, and to superstition, and liable to abuse.

**14—Vegetable Barometers.** M.—In the vegetable kingdom there are many plants which afford

excellent prognostics of the weather. Amongst these we may mention chickweed; when the flower expands fully we are not to expect rain for several hours; should it continue in that state, no rain will disturb the summer's day. When it half conceals its miniature flower, the day is generally showery; but if it entirely shuts up, or veils the white flower with its green mantle, let the traveller take the hint and put on his great coat. The different species of trefoil always contract their leaves at the approach of a storm; so certainly does this take place, that these plants have acquired the name of the husbandman's barometer. The tulip, and several of the compound yellow flowers, also close before rain. There is, besides, a species of wood sorrel, which doubles its leaves before storms and tempests. The baubinia, or mountain ebony, cassia, and sensitive plants observe the same habit.

**15—Hoo Quill Pens are made.** B.—Of the quills of feathers employed for pens, those from the goose are most used. One among many modes of preparing them, is the following:—A workman sits before a small stove fire, into which he thrusts the barrel of a quill for about a second. Immediately upon withdrawing it from the fire, he draws it under the edge of a large blunt-edged knife called a *hook*, by which it is forcibly compressed against a block or plate of iron heated to about 350° Fahr. By this process, the barrel, which is rendered soft and elastic by the heat, is pressed flat, and stripped of its outer membrane, without danger of splitting. It springs back to its natural form, and the dressing is completed by scrubbing with a piece of rough dog-fish skin. The principal workmen employed in this operation can pass 2,000 quills through his hands in a day of ten hours. By whatever process the external membrane is removed, that inside the quill remains shrivelled up in the centre of the barrel, until it is cut open to convert into a pen.

**16—Invention of Lithography.** H. L. B.—The following is said to be the origin of this invention:—"Fifty years ago there lived at Munich a poor fellow, by name Aloys Senefelder, who was in so little repute as an author and artist, that printers and engravers refused to publish his works at their own charges, and so set him upon some plan to do without their aid. In the first place, Aloys invented a certain kind of ink which would resist the action of the acid that is usually employed by engravers, and with this he made his experiments upon copper-plates as long as he could afford to purchase them. He found that to write upon the plates backwards, after the manner of engravers, required much skill and many trials, and he thought that were he to practise upon any other polished surface—a smooth stone, for instance, the least costly article imaginable—he might spare the expense of the copper until he had sufficient skill to use it. One day, it is said, that Aloys was called upon to write—rather an humble composition for an author and an artist—a washing bill. He had no paper at hand, and so he wrote out the bill with some of his newly-invented ink, upon one of his Kilheim stones. Some time afterwards he thought he would try and take an impression of his washing bill—he did, and succeeded. Senefelder invented lithography.



**17—Technology.** MARK.—Ask for “Hazen’s Technology,” which contains a great deal of valuable information on the useful and fine arts.

**18—Study.** S. R.—The best time for this is the morning, when the mind has been invigorated by sleep, and is free from the contact of any objects which may disturb its quiet during the day.

**19—Gum of Postage Stamps.** R. S. U.—We believe it is perfectly innocuous, as it is derived from potato-starch. Death, therefore, may be expected to be somewhat remote from our correspondent, if it is to come only from his “*great licking*” of stamps.

**20—Enamel of Daguerreotypes.** R. G. A.—We understand a plan has been invented and perfected by Mr. Beard (London), for coating the surface of the daguerreotype with a kind of transparent enamel, which effectually excludes the air, renders a glass unnecessary, and besides, permits the application of colour more effectually than by any mode previously attempted.

**21—The progress of Knowledge.** JAMES.—Be not too hurried. Remember that like the march of the sun, the progress of knowledge is slow, and although you at present do not see what advances you have made, any more than you can see the motion of the sun, yet you will find, by-and-by, that you have moved towards your object as certainly as he has moved towards the end of his journey.

**22—Synonymy.** P. D.—Crabbe’s great work on this subject is superior, in our opinion, to all the others on the same put together. Some of his comparisons seem, certainly, in several instances, to be very remotely related; but there is a solidity of judgment united to a niceness of discriminative power which have deservedly placed his work in the high position it maintains. Graham’s is also a good work, but by no means pretending to the universality of Crabbe.

**23—Soils.** INQUIRER.—The fundamental practices of good farming in England are draining, weeding, and manuring: and the soils are argillaceous, silicious, or calcareous, with vegetable remains which, variously mingled, make up loamy, chalky, clayey, sandy, gravelly, and peat soils. Loam is a mixture of clay, silicious sand, and carbonate of lime, and is the most fertile soil. Clay is alum deprived of its sulphuric acid, sea sand is the powder of flints, and carbonate of lime is the powder of marble, chalk, limestone, bones, shells, &c.

**24—Dinner.** M. A. C.—Five hours. “Supposing nine o’clock to be the hour of breakfast,” observes Dr. Combe, “the natural dinner-hour would be two o’clock,” and such, accordingly, is that sanctioned by the most extended experience, and which ought to be adhered to by all those whose pursuits will admit of such an arrangement, and who desire to enjoy the highest degree of health of which the body is susceptible. This rule for adults may be, generally, considered a good one, to which, however, exceptions will often occur.

**25—Saracen.** R. T.—About the Middle Ages this term was applied indiscriminately to both Pagans and Mahometans, and generally to all persons not professing the Christian religion. In the romance of “Richard Cœur de Lion” we have the following couplet:—

“That Jesu him helped, it was well seen,  
The *Saracens* were i-slayn all clean;”

and also in a couplet in the tale of Merlin, we find the name introduced:—

“After many *Saracens*, stout and dark,  
At Saxonye and of Denmark.”

**26—Organs.** G. C. P.—The organ was invented about 951, the first being erected in Winchester Cathedral; it was described by a monk in Latin verse, thus translated:—

Twelve pair of bellows ranged in stately row,  
Are joined above, and fourteen more below,  
These the full force of seventy men require,  
Who ceaseless toil, and plenteously perspire;  
Each aiding each, till all the wind be prest  
In the close confines of the incumbent chest,  
On which four hundred pipes in order rise,  
To bellow forth the blast that chest supplies.

**27—Facility of Swimming.** C.—The lighter the body is in relation to its magnitude, the more easily will it float, and a greater proportion of the head will remain above the surface. As the weight of the human body does not always bear the same proportion to its bulk, the skill of the swimmer is not always to be estimated by his success: some of the constituent parts of the human body are heavier, while others are lighter, bulk for bulk, than water. Those persons in whom the quantity of the latter bear a greater proportion to the former, will swim with a proportionate facility.

**28—Chicory.** L. R. A.—It is the root of the wild endive, and is extensively cultivated in Holland, Belgium, and Germany, whence it is largely imported for the purpose of adulterating coffee. The root is cut, dried, and roasted in heated cylinders, so as to resemble coffee, and then ground in mills. Because it is innocuous, it is much used by grocers, and because many persons prefer it mixed with the genuine article. It is, itself, however, sometimes adulterated by means of roasted corn which has been damaged, and peas, beans, coffee husks, &c., whilst Venetian red, or Armenian bole, is employed as a colouring agent.

**29—Regularity.** A YOUTH.—You must be aware that the habit of regularity is acquired as the natural result of a good system of tuition, and although men called “great” have been irregular, and even erratic, yet would they have been still greater had they not possessed these positive faults. Let your training, then, be of the most settled kind possible, and you will soon feel its pleasantness, as well as the advantages which all experience has taught us to arise from such a course. General Washington was a very “great” man, and his confirmed habits of extreme punctuality tended greatly to render him such.

**30—Why Cream collects on the surface of Milk.** M. R.—There are numerous familiar effects which are manifestations of the principle now explained. When a vessel of milk is allowed to remain a certain time at rest, it is observed that a stratum of fluid will collect at the surface, differing in many qualities from that upon which it rests. This is called *cream*; and the property by which it ascends to the surface is its relative levity; it is composed of the lightest particles of the milk, which are in the first instance mixed generally in the fluid; but which, when the liquid is allowed to rest, gradually arise through it, and settle at the surface.

**31—Manufactures.** G. D.—The fur robe of which you speak, formed a portion of the contributions to the Russian department of the Exhibition, and it certainly does at first appear as cruel as extraordinary that no fewer than seventeen hundred black foxes should have been slaughtered to make it. It was valued, however, at sixteen thousand dollars. Now, as we are all aware of the destructive propensities of the fox, were these animals not better converted into a fur robe than running wild committing wholesale depredations upon the less powerful, but more necessary species of live stock, in which they are known to indulge?

**32—Banneret.** P. F.—It is a term expressive of an ancient order of knights who, possessing several large fees, led their own banner. It often occurs in the chivalric prose of old Froissart and frequently in the chivalric poetry of Sir W. Scott. After the decline of Feudalism, the honour of being a Banneret became merely titular. The last knight of this description was Sir John Smith, on whom the title was conferred after the battle of Edgehill, for rescuing the standard of the unfortunate Charles I. The mode of conferring the honour in the day of battle was by the king or general cutting off the tail of the candidate's flag and making it a square, in which form it was returned. From this circumstance Bannerets are sometimes called Knights of the Square Flag.

**33—Sulphur.** A STUDENT.—It is an elementary or undecomposed body, which, in nature, sometimes occurs pure, but more commonly in combination with the metals forming sulphurets. The greater part of that which is used in the arts is the produce of volcanic countries. Its colour is yellow, with a slight shade of green; it is nearly inodorous and tasteless, insoluble in water, and is, with difficulty, dissolved in spirits of wine. At a moderate temperature it melts, and at a higher is converted into vapour. It burns readily, with a lambent blue flame, and suffocating vapours of sulphurous acid are formed by its combining with the oxygen of the air during combustion. When pure or crystallized, it is frequently translucent. The primary form of the crystal is an acute octahedron, with a rhombic base, subject to various modifications.

**34—Origin of the word Taxes.** W. G.—The word Taxes is derived from the barbarous Latin word *Tallia*, or *Tallium*, which in the ancient signification (says Fortescue) meant a piece of wood, squared and cut into two parts, on each of which they used to mark what was due and owing between debtor and creditor; from thence it came to signify a tribute paid by the vassal to the lord, on any important occasion, the parti-

cular payments whereof were marked on these pieces of wood, one part being held by the tenant, the other by the lord. In French it is *Taille*, which originally signified no more than a section or cutting, from the verb *tailler*, to cut; but afterwards it came to signify metaphorically a tax, or subsidy: all which words come from the pure Latin word *Talea*, a cut stick, or tally. From whence is derived our law Latin word *Tallagium*, or rather *Talliagium*, which signifies in our law any sort of tax whatsoever.

**35—Red Hair.** PINXIT.—From all we can learn, the dislike, of which you complain would seem to have arisen during the time of the Anglo-Saxons, who are said to have had an inveterate antipathy to that quality of colour in the human hair. This animosity, perhaps, took its origin from red being so predominant amongst their enemies, the Danes. In days of yore painters uniformly represented the traitor Judas with red hair, and many instances might be given to show that this absurdity continued down to a very recent period, and indeed cannot, even yet, be said to be wholly extinct. We, ourselves, know a lady of unquestionable beauty of facial feature, which is capped by a red head, over which we have been sorry to hear her pour many a piteous complaint. In an old play, entitled "Bussy d'Ambois," the following line occurs:—

"Worse than the poison of a red-hair'd man,"

which sufficiently indicates the detestation in which that colour was held when found surmounting the human face divine. But after all that may be said, the objection is as weak as are all such objections,—they arise from a want of reflection.

**36—Sagacity of Natives.** A. G. L.—The circumstance has been attested by hundreds of travellers and in various portions of the globe. A Bedouin, for example, will tell from the impression made by the footsteps whether a man carried a load or not, and will know also whether it was made, as it were, to-day or two or three days ago; he will also know whether the man was fatigued or not, and whether there was a possibility of overtaking him within a given time were he to pursue him. The Arab is, likewise, not only familiar with the printed footsteps of his own camels, but of those of his neighbours, and Burckhardt affirms that the conclusions at which he will arrive in many cases from the examining of foot-prints alone, appears almost superhuman. The North American Indian will discover, by the prints of the feet and other signs perceptible only to himself, not only that men have passed through a particular path, but whether they belong to his own or another nation, and thereby judge whether they are friends or foes. The Hottentots and South Africans discover similar marks of sagacity and even some of our own countrymen, as may be instanced in the case of the Honourable Mr. Murray in his wanderings amongst the Pawnees, who, as he was often in fear of an attack, became so expert in reading the trail of foot-prints, that he could decide whether it was made by a friend or a foe, and give many other instances of that peculiar kind of sagacity which distinguishes alike the savage inhabitant of the wood and the wandering dwellers in the desert.



**37—Instinct and Intellect.** D. E.—Intellect we conceive to be the result of an aggregate of the rational faculties of man: instinct, in the sense used by you, as rather the expression or result of feeling.

**38—Androides.** A. P. R.—Self-acting figures in the form of men. Modern times have produced us several remarkable examples; as in the case of the flute-player of Vaucanson, constructed and exhibited at Paris; the chess-player of M. de Kempelin of Presburg, and the chess-player exhibited some time ago in London.

**39—Globular Chart.** A. B. C.—It is just a synonyme for a map; it is, however, perhaps, the better term to express the superficial representation of the terrestrial globe upon a plane wherein the parallels of latitude are circles, nearly concentric, the meridian curves bending towards the poles and the rhumb-lines are also curves.

**40—How to Refuse.** G. L.—The act was sudden, and although perhaps, not positively severe, yet severe enough. Always when you have to give a painful refusal, do it as gracefully and sympathisingly as you can. Feelings are tender things, and he who can soften the pain of an ungracious act is unpardonable if he does not do so.

**41—Why Money is called Sterling.** F. G.—Because in the time of Richard Cœur de Lion, money coined in the east part of Germany became, on account of its purity, in especial request in England, and was called Easterling money, as all the inhabitants of that part of Germany were called Easterlings; and soon after, some of this people, skilled in coining, were sent for to London, to bring the coin to perfection, and hence the adoption of the name of sterling to designate it.

**42—Laconism.** J. S.—No. A laconism is not a maxim; the former is only a short pointed saying, taking its rise from the brief and pithy manner adopted by the ancient Lacedæmonians in expressing themselves; whereas the latter carries something in it to be remembered, either for the practical gravity of its wisdom, or the humorous applicability of its sense. For example, "Better small help than none," as we find under the humorous wood-cut of our HEME COMPANION, is a maxim; but when the ancient General was told that the spears of the enemy were so numerous that they darkened the sun, and when he said "Then we will fight in the shade," he uttered a laconism.

**43—Value of Hedges.** L. S.—As in the case of water, its value is never felt until the well is dry. Travellers in the north of France, say that where there is an almost total want of hedges so is there almost a total want of birds, and consequently there is no limit set to the ravages of the caterpillar, or the destruction of the grub. Hundreds upon hundreds of the *Pontia rapae* may be seen upon the wing at one time, whilst the *Scarabæus melolantha* flies in myriads, and there being no rooks to follow the plough, the land may be said to be literally devoured by grubs. From this circumstance, the value of hedges, if for nothing else but as a shelter to the feathered tribes, will, at once, be inferred.

**44—Decision of Character.** D. G.—Cultivate it steadily and with a view to this we would advise you not only to read, but to re-read

Foster's Essay on "Decision of Character." A youth of undecisive character is always wondering how all the difficulties and embarrassments in the world come in his way. He thinks himself one of the most unfortunate of beings, and that he is marked out by some stern necessity to be doomed to perpetual trouble. He thinks how determined and clear a course he would have run, if his talent, his health, his age had been different; and thus does he dream on what would have been, in place of catching with a vigilant eye and seizing with a strong hand, all the possibilities of his situation.

**45—Lama.** T. G.—The pontiff of Tartary and Thibet and the pretended delegate of Heaven. His people believe that the Supreme Being lives in him, as he is never to be seen but in the secret recesses of his palace, where he sits cross-legged upon a cushion,—a position by-the-by, not very dignified, in our estimation, for one of such lofty pretensions. In the deep recesses of his heart he is also believed to see and know every thing, and is supposed never to die, but to

"Shuffle off his mortal coil,"

and spiritually enter into the body of a new-born child. He is worshipped by prayers and clamorous songs, in magnificent processions, in personal austerities and the solemnization of certain festivals. The whole evincing in a remarkable degree to what extent superstition will carry its victims.

**46—The Mariner's Compass.** B. A.—It was invented by one Flavio Gioia, a citizen of Amalfi, in the kingdom of Naples, and about the year 1302. Although its use might enable Italians to perform the short voyages to which they were accustomed with greater security and expedition, yet its influence was neither so rapid nor extensive as to excite a spirit of discovery by rendering navigators more adventurous in exploring the deep. Seamen unaccustomed to quit the sight of land dared not launch out at once, and commit themselves to unknown seas. Accordingly it took nearly half a century after Gioia's invention to secure for it such confidence as enabled navigators to venture upon strange seas or beyond such limits as they had been accustomed to frequent.

**47—History and Romance Composers.** W. F.—It is generally affirmed that a novelist does not make a good historian,—and *vice versâ*, an investigator and compiler rarely makes a good novelist. In fiction, the writer must aim constantly at effect, and work by invention,—in history, he must achieve his object by narration of facts laboriously collected, and judiciously investigated. Hence there is an opposite exercise of the mental faculties. A man who might do well in either pursuit would not succeed in both. The poetry of Lamartine has been found to give too much colour to his histories. In the same way history in the hands of Sir Walter Scott was too anecdotal, and too full of mere individualities. Smollett's historical performances were written with a party prejudice, enhanced by the fanciful workings of a novelist's intellect. Numerous cases might be quoted to prove this position.

**48—Resolution.** G. T.—Where the determination is strong and fixed to attain an object, it is generally sufficient in itself to create the

means, and almost any means are sufficient. It is a mistake which has, times out of number, been proved, to suppose that there is only one way of doing a thing, namely, that in which it is commonly done. Let but necessity come in, and we find how amazingly rich we become in resources, and that it is seldom in the absence of the ordinary instrument, but some new invention is ready to supply its place. Of the truth of this studious poverty has often had experience, and no doubt been all the better for experiencing; for obstacles encountered and surmounted, not only sharpen invention, but strengthen the whole intellectual and moral character, and fit him to battle for and achieve future successes from which less severely trained spirits would turn in despair.

**49**—*I can't do it.* G. F. S.—We cannot recommend anything better to stimulate you to renewed exertion than the advice of *La Bruyere*, which we translate for your sake. "I can't do it."—Yes you can. Try—try hard, try often, and you will accomplish it. Yield to every discouraging circumstance, and you will do nothing worthy of a great mind. Try, and you will do wonders. You will be astonished at yourself—your advancement in whatever you undertake. "*I can't*" has ruined many a man—has been the tomb of bright expectation and ardent hope. Let "*I will try*" be your motto in whatever you undertake, and, if you press onward, you will steadily and surely accomplish your object and come off victorious. Try—keep trying—and you are made for this world. How happy the station which every minute furnishes opportunities of doing good to thousands! How dangerous that which every moment exposes to the injuring of millions.

**50**—*Allegory.* S. R.—It has been defined as a species of writing in which one thing is expressed and another thing is understood. The analogy is intended to be so obvious that the reader cannot miss the application; but he is left to draw the proper conclusion for his own use. One of the most correct, and, perhaps, most beautiful allegories we have, is to be found in the 80th Psalm, from the 8th to the 16th verse, where a vineyard is made to represent God's people, the Jews. Another beautiful example is to be found in Prior's "*Henry and Emma*," where *Human Life* is the primary object, and a *royage* the allegorical one. Emma addresses Henry:

"Did I but purpose to embark with thee

On the smooth surface of a summer's sea,

While gentle zephyrs play in prosperous gales,

And fortune's favour fills the swelling sails,

But would forsake the ship, and make the thee shore,

When the winds whistle and the tempests roar?  
No, Henry, no."

**51**—*Miscellaneous Reading.* C. R.—It is generally condemned as unprofitable; yet a miscellaneous reader is usually possessed of a vast store of that kind of knowledge which gains a character for intelligence in current society. He can say something about everything, although, perhaps, a philosopher would say that he knows nothing of anything. For those who are desirous of mastering any particular branch of science or literature, we should say its practice is bad. These should devote themselves steadily to their

object until it is obtained; for inasmuch as the mind is diverted from that object, so will the progress towards its attainment be proportionably slower. Mental energy is not to be preserved along with mental dissipation; and the rays of the sun are felt to be the strongest where most concentrated. Notwithstanding this truth, however, he who adheres only to one subject, will know only that subject, like Hogarth's dancing-master, whom he heard say that he had made the minuet the study of his whole life, and had been indefatigable in the pursuit of its beauties; yet, at last, he could only say with Socrates, that "he knew nothing."

**52**—*Similarities.* B. U. R.—It may be so, but we think the resemblance will be found more fanciful than real. The celebrated Dr. Beattie has furnished us with a somewhat minute detail of the personal habits and peculiarities of several leading characters among the literati; and from the coincidence of which, in himself, he affects to augur he also was in the way of becoming a great man. "Have I not," says he, "headaches like Pope, vertigo like Swift, gray-hairs like Homer? Do I not wear large shoes for fear of corns like Virgil, and sometimes complain of sore eyes like Horace? Am I not at this present, writing, invested with a garment not less ragged than that of Socrates? Very lately, in imitation of Don Quixote, did I not ride a horse, bare, old, and lazy like Rosinante? Sometimes like Cicero I write bad verses, and sometimes bad prose like Virgil. I am somewhat inclinable to fatness like Dr. Arbuthnot and Aristotle, and I drink brandy-and-water like Mr. Boyd. In relation to many other infirmities, I might compare myself to many other great men; but if fortune is not influenced in my favour by the particulars enumerated, I shall despair of ever recommending myself to her good graces."

**53**—*Physical Training.* H.—We have instances every day of the high state of health into which a man may be brought by such training as relates to exercise and living. The man who is put under a regular or systematic course of duties by an experienced trainer will in a very short time acquire a development of muscular power amazing to himself. The usual mode, as recently given by the "*Medical Times*," is to retire early to bed, which is to consist of a mattress with sufficient covering to ensure a suitable warmth without encouraging unnecessary perspiration. Rise betimes in the morning, and, after a general washing and rubbing, partake of a slight repast, and commence the day's work by a quick walk of a few miles. Then return home and eat with what appetite you can. After a short rest, again to exercise until next meal-time, and so on throughout the day. The diet should be chiefly confined to the lean of under-done beef and mutton, fowl, and stale bread. Two or three glasses of sherry are recommended, with, perhaps, a little old ale daily. The distance to walk or run every day to vary from ten to forty miles, beginning with what can be conveniently borne, and increasing in proportion to increasing strength. In every study health is necessary to prosecute it with success, and all persons, male and female, should keep themselves in that condition by such a practice of physical duties as they can well bear.



**54—Love Romances.** T. P.—It is to Boccaccio, of Italy, and contemporary of Petrarch, that the invention of love romances is ascribed. Such compositions were wholly unknown to antiquity.

**55—Monarchy.** H. A.—The most ancient was that of the Assyrians, which was founded soon after the deluge. Historians reckon four grand or almost universal monarchies: the Assyrian, Persian, Grecian, and Roman.

**56—Lalla Rookh.** P. S.—Three thousand guineas was the price paid by Messrs. Longmans' for Moore's Poem, and this sum was agreed for before almost any of the romance was written—a proof of the confidence which successful genius will inspire even in mercantile men.

**57—Lyric Poetry.** M. G.—In ancient times, every poetical composition which was accompanied with music whether of the voice or of instruments, was called Lyric. Its name is derived from the lyre with which it was commonly attended, and it acquired the name of ode, because it was also designed to be sung.

**58—Aster.** A. S.—The name was first given by Dr. Herschell to the new planets Ceres, Juno, Pallas, and Vesta, recently discovered, which he defines as celestial bodies moving in orbits of little eccentricity round the sun, the plane of which may be inclined to the ecliptic in any angle whatsoever.

**59—Kaleidoscope.** T. R.—No; it is of modern date. It was invented by Dr. Brewster, of Edinburgh, was first suggested in 1814, and perfected in 1817, when it found its way into the hands of everybody. It is intended to assist jewellers, glass-painters, and other ornamental artists, in the formation of patterns, of which it produces an infinite number.

**60—Epic Poems.** T. V.—The epics of Homer and Virgil, the "Gierusalemme" of Tasso, the "Paradise Lost" of Milton, and the "Henriade" of Voltaire, are the noblest that exist. Milton's is considered to rank next to Homer's. "'Paradise Lost' is not the greatest of epic poems," observes Dr. Johnson "only because it is not the first."

**61—Hiccius Doctus.** L. R.—The expression is a corruption of *hic est doctus* (this is the learned man), cant words used by jugglers in the exhibition of their tricks, and hence it became a name for a juggler or deceitful tricking person. Butler uses the term in the following lines of "Hudibras":

An old dull sot, who toll'd the clock,  
For many years at Bridewell dock,  
At Westminster and Hicks' Hall,  
And *hiccius doctus* play'd in all.

**62—The Albatross.** J. M.—The poem alluded to was written by Coleridge, and the "Albatross" forms one of the most striking features throughout the piece. His flight is particularly solemn. He soars along with widely expanded wings that often measure fifteen or eighteen feet between the tips, at an even, steady rate, rarely seeming to stir, but as if merely floating along. Now and then a slow flapping motion serves to raise him higher in the air, but the swift movement and busy flutter of other birds seem beneath his dignity.

**63—Kings' Colleges.** A. B.—There are four. That of Aberdeen, founded in 1500; King's College, Cambridge, the pride of that university, was founded by Henry VI., in 1441; King's Col-

lege, Halifax, chartered in May, 1802; King's College, London, incorporated August 14, 1829, and opened October 8th, 1831. Its object is to secure to the rising generation in the Metropolis, and its vicinity, the benefits of an economical, scientific, and religious course of instruction, according to the doctrines of the Church of England.

**64—Turkish Assembly of Knowledge.** P. A.—Yes, and also in Constantinople an Academy of Sciences, under the title of an Assembly of Knowledge, has during the passed year been formed. It is composed of forty native members, and an infinite number of foreign correspondents. The statutes declare the object of the Institution to be the publication of original scientific works, and the translation into Turkish foreign works, of importance. The first labour of the Academy will be the compilation into the Turkish language of an Encyclopædia of the Sciences.

**65—The Laurel.** E. M.—It was sacred to Apollo, and from the earliest times the poets and generals of armies, when victors, were crowned with laurel. Apollo, being the God of Poetry, led to its use among the poets; and the Roman victors sent home their accounts of successful enterprises to the senate wrapped up in the leaves of laurel. It was also dedicated to Jupiter, and chosen for this purpose because the lightnings do not blast it as they do other trees. It signified honour, conquest, triumph, favour, and preservation. Petrarch, the Italian poet, was crowned with laurel, April 8, 1341.

**66—Ladies.** P. D.—The mistresses of manor-houses, in former times, served out to the poor, weekly, with their own hands, certain quantities of bread, and were therefore called *Lef-days*—two Saxon words signifying *bread-giver*,—and the words were at length corrupted; and the mistress is, to this day, called *Lady*—that is *Lef-day*. The introduction of ladies to court was, first, to that of Louis XII. of France, in 1499. As a title of honour, the title of lady properly belongs only to the daughters of earls, and all of higher rank; but custom has made it a term of complaisance for the wives of knights, and all women of eminence or gentility.

**67—Canonical Hours.** G. R.—They are the seven hours of prayer observed, it is said, by the Catholic church, chiefly in monasteries, since the fifth century. The number, before that time, seems to have varied, although some peculiar seasons of the day and night were always set apart for this observance. They became finally fixed at seven by the rule of St. Benedict; a number, perhaps, recommended by the liberal acceptance of the words of David, "Seven times a day will I praise thee." At the time of the Reformation the canonical hours were reduced in the Lutheran church to two, morning and evening; the reformed church never observed them.

**68—Alsatia.** D. E.—A description of it will be found in "The Fortunes of Nigel." The name was given to a precinct of Whitefriars, near the Temple; it was called Alsatia the higher, to distinguish it from the Mint, which was called Alsatia the lower; both places enjoyed certain privileges, particularly arrest from civil process, and in consequence became the resort of the profligate and abandoned of both sexes, and the scene of frequent riots and disturbances. By an

Act of William III. these and several other privileged places were put down. Tom Shadwell has dramatised the manners and language of the Alsatians in a satirical comedy, called *The Squire of Alsatia*, which was acted in 1688.

**69—The Moon's motions.** S. L. A.—The inequality of the moon's motions are divided into periodical and secular. Periodical inequalities are those which are completed in comparatively short periods. Secular inequalities are those which are completed only in very long periods,—such as centuries or ages. Hence the corresponding terms periodical equations and secular equations. As an example, of a secular inequality, we may mention the acceleration of the moon's mean motion. It is discovered that the moon actually revolves around the earth in a less period now than she did in ancient times. The difference, however, is exceedingly small, being only about ten seconds in a century.

**70—Superficies of Seas.** S. T.—The surface of the sea is estimated at 150 millions of square miles, taking the whole surface of the globe at 197 millions, and its greatest depth, is supposed to be equal to that of the highest mountains, or four miles; but La Place thinks that the tides demand an average depth of three miles; therefore the sea contains 450 millions of cubic miles of the 258,000 millions in the whole globe.—The Pacific Ocean covers 78 millions of square miles, the Atlantic 25 millions, the Indian Ocean 14 millions. The Southern Ocean to 30 degrees, is 25 millions; the Northern Ocean 5 millions; the Mediterranean, one million; the Black Sea, 170,000; the Baltic, 175,000; the North Sea, 160,000.

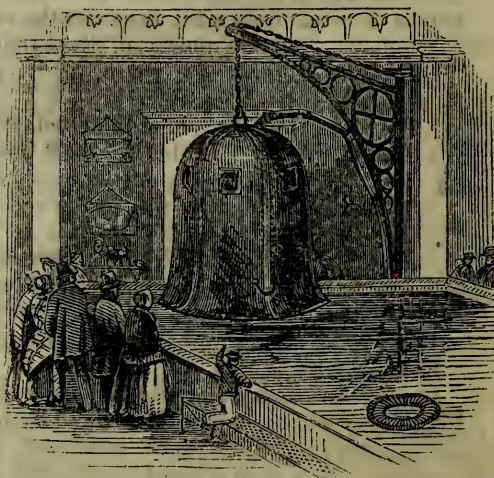
**71—Latin Language.** R. L.—It is one of the thirteen original languages of Europe, from which sprung the Italian, French, and Spanish. It is named after the Latini, and the Latini from Latinus their king. A vast portion of our most beautiful and expressive words are derived from the Latin. It ceased to be spoken in Italy about the year 581: and was first taught in England, by Adelmus, brother of Ina, in the seventh century. During six or seven hundred years, the Latin tongue prevailed in all public proceedings, from the Tweed to the Euphrates, and from the Danube to Mount Atlas, and has been more or less retained even to this day. In England, it was ordered to be discontinued in conveyancing, in courts of law, in 1731.

**72—Halos.** M. S.—A halo is a circular band of faintly coloured light, which is occasionally seen surrounding the disc of the sun or moon at a distance from it equal to twenty-two or twenty-three degrees, measured on a great circle passing through the luminary. The colours of the solar halo are such as are observed in the rainbow, but are less bright, and they do not always in the halo follow the same order as in the bow. Generally the red is nearest the sun, the exterior of the band being a pale indigo or violet and sometimes white; but occasionally the interior edge appears to be white, and beyond this, in succession are green, yellow, and a pale red. The lunar halo, in general appears to be white, but it is at times tinted with pale green or red.

**73—The Title of Esquire.** G. A. M.—The application of the title in the case alluded to is improper, but passes current in society as a mark of courtesy. Real esquires are of seven

sorts. 1. Esquires of the King's body, whose number is limited to four. 2. The eldest sons of knights, and their eldest sons born during their lifetime. It would seem that in those days of ancient warfare, the knight often took his eldest son into the wars, for the purpose of giving him a practical military education, meanwhile employing him as his esquire. 3. The eldest sons of the youngest sons of the peers of the realm. 4. Such as the King invests with the collar of S. S., including the king of arms, heralds, &c. The dignity of esquire was conferred by Henry IV. and his successors, by the investiture of the collar and the gift of a pair of silver spurs. Gower, the poet, was such an esquire by creation. 5. Esquires to the Knights of the Bath, for life, and their eldest sons. 6. Sheriffs of counties, for life, coroners and Justices of the Peace, and gentlemen of the Royal Household, while they continue in their respective offices. 7. Barristers-at-law, doctors of divinity, law, and medicine, mayors of towns, and some others, are said to be of scutarial dignity, but not actual esquires. Supposing this enumeration to comprise all who are entitled to esquireship, it is evident that thousands of persons styled esquires are not so in reality. It is a prevailing error that persons possessed of £300 per annum, in land, are esquires. Nothing but one or other of the above-mentioned circumstances can confer the dignity.

**74—The Diving Bell.** M. O.—The principle of the Diving-bell of which we give an illustration, depends upon the impenetrability of atmospheric air, and may be explained by a very familiar experiment. Bring the edge of an inverted



tumbler, or any close vessel to the surface of water, and, keeping the mouth horizontal, press it down in the water. It will be seen that though some portion of the water ascends into the tumbler, the greater part of the space remains empty, or only filled with air; and any object placed in this space, though surrounded on all sides with water, would remain perfectly dry. In fact, the quantity of air remains the same, but it is compressed into a smaller volume, in proportion to the depth to which it is made to descend.



**75—Rapid Speakers.** E. M.—Rapid speakers pronounce from 7,000 to 7,500 words per hour, or about two words per second.

**76—Metals.** C. S.—Yes, metals are considered as undecomposable substances, yet all those that are inflammable must contain hydrogen.

**77—Immobility of Bodies.** B. E.—Bodies at rest never move, unless some force is impressed on them in the direction of any motion which they acquire.

**78—Archaism.** T. M.—It is any antiquated word or phrase. The use of archaisms, although generally objectionable, occasionally add to the beauty and force of a sentence.

**79—Fluids of Animal Bodies.** T. A.—These, in their chemical properties, are watery, albuminous, mucous, oleaginous, resinous, saline, gelatinous, and fibrinous. Of these, the solids are continued secretions in laminæ, and fibres, or filaments, or tissues.

**80—Pica.** S. A.—It is a name given to a type of moderate size, in printing, so called because it was used in printing the *Pic*, the service-book of old Catholic times, which, again, is supposed to derive its appellation from the *piecolor* of the text and rubric.

**81—Electrics and Non-electrics.** C. A.—An electric or non-conductor is a body in which the combination of the same elements are easily disturbed and placed in correlative action and reaction on surfaces of adjoining non-electrics. A non-electric or conductor is a physical surface in which the elements of oxygen and hydrogen are so intimately combined as not to be separable.

**82—Dieu et mon Droit.** S. T.—The royal motto was first assumed by Richard Cœur de Lion, to intimate that he did not hold his empire in vassalage of any mortal. It was afterwards taken up by Edward III., and was continued, without interruption, to the time of William III. who used the motto *Je Maintiendrai*, though the former was still maintained upon the great seal. *God and my Right* still continues to be the royal motto.

**83—Silvering.** J. W.—The dial-plates of clocks, the scales of barometers, and other similar articles, are silvered by rubbing upon them a mixture of muriate of silver, sea-salt, and tartar, and afterwards washing off the saline matter with water. In this operation the silver is precipitated from the muriatic acid, which unites with part of the coppery surface. Silvering of pins is effected by boiling them with tin filings and tartar.

**84—Source of Moral Sublimity.** T. G.—High virtue is the most natural and fertile source of moral sublimity. However, on some occasions, where virtue either has no place, or is but imperfectly displayed, yet, if extraordinary vigour and force of mind be discovered, we are not insensible of a degree of grandeur in the character, and from the splendid conqueror or daring conspirator, whom we are far from approving, we cannot withhold our admiration.

**85—Conductors of Sound.** M. O.—Water is a better conductor of sound than air. Wood, also, is a powerful conductor of sound, and so is flannel and ribbon. In water a bell does not produce a tone, but a short noise like two knives struck together. The agitation of the water produces no change. In the water a large bell is

heard 45,000 feet; but in the air, out of the water, but 655 feet.

**86—Introduction of Gold.** S. J.—Gold coin was introduced by Edward III., in six shilling pieces, nearly equal in size to a modern sovereign. Nobles followed at 6s. 8d.,—hence the lawyer's fee; afterwards there were half and quarter nobles. Edward IV. coined angels, with a figure of Michael and the Dragon. Henry VIII. coined sovereigns and half-sovereigns of the modern value. Guineas were the same size, but being made of superior gold from sovereigns, guineas passed for 21s., and in 1798, for 30s.

**87—Minstrels.** D. E. S.—They were originally pipers appointed by lords of manors to divert their copy-holders while at work. They owed their origin to the glee-men or harpers of the Saxons, and continued till about the year 1560. John of Gaunt erected a court of minstrels at Tutbury, in the year 1380. So late as the reign of Henry VIII., they intruded without ceremony into all companies, even at the houses of the nobility. In Elizabeth's reign, however, they had sunk into neglect.

**88—Freezing Water.** O. P.—Leslie's method of freezing water by the air-pump, consisted in absorbing the moisture by a saucerfull of oil of vitriol, and merely having the expansion without the moisture. When the air is rarefied 250 times, water under the receiver is cooled down 120 degrees. In this experiment, the motion which kept the water liquid is transferred to the sulphuric acid, and the water then fixes or crystallizes,—but, if left in the rarefied air, it entirely evaporates after it has become ice.

**89—Mountains.** K. P.—Mountains are the nodes or projections of the granite nucleus, the transition or secondary formations. Granitic mountains are rugged and precipitous, gneiss less so, and slate smooth and round. The European and Asiatic mountains are crowned with granite; but the Andes are topped with whinstone, or the newest floetz trap; and granite does not rise higher than eight or ten thousand feet. Chimborazo has porphyry at its summit, and Pichincha basalt. Limestone is also found at great elevations.

**90—Ranz de Vaches.** W. I.—It is a favourite national air amongst the Swiss shepherds, which they play upon their bagpipes while tending their flocks and herds. It consists of a few simple intervals, is entirely adapted to the primitive life of these people and their instrument (the Alpen horn), and has an uncommon effect in the echoes of the mountains. This effect becoming intimately associated with the locality of Switzerland, explains the cause of so many anecdotes of the home-sickness caused by the sound of the *Ranz de Vaches*, when heard by the Swiss in foreign countries.

**91—Mareschal or Marshal.** M. Q.—In France, marshals were the ancient esquires of the king; and by their first institution they had the command of the vanguard, to observe the enemy, and to choose proper places for its encampment. Till the time of Francis I., in the year 1515, there were but two French marshals, who had 500 livres per annum in war, but no stipend in time of peace. The rank afterwards became of the highest military importance, the number was without limit, and the command supreme. During the empire of Napoleon, the marshals of France filled the world with their renown.

**92—Newspaper Reporting.** D. B.—It was about the commencement of the year 1771 that newspapers began to report the parliamentary debates. Before this time they had only been given in Monthly Magazines and other periodicals published at considerable intervals. The idea of daily reporting them was an innovation on the former practice, and in direct violation of the standing orders of the House. Accordingly, there were several complaints and apprehensions of printers about it, but eventually the matter was suffered to drop, and ever since parliamentary proceedings have been regularly reported.

**93—Waterloo.** Q. A.—Yes, it is an historical fact that the British forces have been twice signally successful, over those of France, on the same ground,—Waterloo; and that by the side of the very chapel of Waterloo, which was remarked for remaining uninjured by shot or shell on the memorable 18th of June, 1815, did Marlborough cut off a large division of the French forces opposed to him, on the 17th of August, 1705. It is also a fact that the conquerors of each of those days, on the same field, are the only commanders in the British service whose military career brought them to the summit of the peerage,—to dukedoms.

**94—Doomsday Book.** R. I.—It is a record made by order of William the Conqueror, which now remains in the Exchequer, and consists of two volumes, a large folio, and a quarto; the former contains a survey of all the lands in most of the counties of England, and the latter comprehends some counties that were not then surveyed. The book was begun by five justices, assigned for that purpose, in each county, in the year 1081, and finished in 1086. It was of such authority that the Conqueror himself submitted, in some cases wherein he was concerned, to be determined by it. Camden calls it the *Tax Book of King William*.

**95—Dials.** L. A. M.—In constructing a sundial the object is to find, by means of his shadow, the sun's distance at any time from the meridian. When this distance is known the hour is also known, provided we suppose the sun's apparent motion to be uniform, and that during the whole course of a day, he moves in a circle, parallel to the equator. Neither of these conditions is, in fact, accurately fulfilled, but the error which this gives rise to is of small importance; and it is, moreover, sufficiently obvious, that the use of a dial is not to indicate the hour with astronomical precision, but merely to give such an approximation as is necessary for the purposes of civil life.

**96—Algæ.** P. D.—Algæ are, at once, the green covering of stones, or surface of ponds; and those submarine forests which obstruct navigation, and grow to the length of twenty-five or thirty feet, with trunks two feet round; and in other cases to one thousand feet and not two inches round. They also produce the first stratum of fertile soil, and in their decay are the first source of all vegetation; so that one order of vegetables grows out of the relics of previous orders. Countless ages must have passed in the transition of Algæ into the food of vegetables, but as they increase so much in water this explains the use of the alternate submersions of seas.

**97—The Poet Young.** M. G.—We cannot agree with you, for we think that Young has much

merit as a satirist. He is not so severe as Juvenal, but he is always in earnest, and never attempts to excite a laugh. He appears as a sincere moralist, zealous to correct the vices and follies of mankind, by holding up pictures calculated to excite their reflection on the culpability of their errors. His "Love of Fame" displays much knowledge of human nature, and no small merit in point of versification. He is a satirist whom we both love and respect, because we conceive him to be actuated by good-nature, and diffident of reprehending were it possible to reform by gentler means.

**98—Dedications.** C. H.—These are complimentary addresses to particular persons, prefixed by authors to their works. They arose out of the dependent position in which authors have too often been placed in reference to their powerful or wealthy patrons; and at no very distant date were frequently rewarded by pecuniary presents. The custom of dedicating works was in use at a very early period. The brightest ornaments of Roman literature, Horace, Virgil, Cicero, and Lucretius, were among the number of those who practised it. In recent times, both Dryden and Johnson wrote dedications for money. Some of the most beautiful with which we are acquainted are those prefixed to the different volumes of the "Spectator," by Addison; as also the poetical dedications with which each canto of Sir W. Scott's "Marmion" is prefaced.

**99—Coal in China.** M. S.—To a greater or less extent, coal deposits exist throughout mountain ranges which girt the great plain of China. On its northern boundary it is met in numerous localities, on the Chingai mountains, on the Mongolian steppes, and various off-sets of the Altai range, the most productive of which are in Shinking and Shansi. There are several smaller deposits in Chihli and Corea. Unskilful mining and the want of suitable means of transport enhance the cost of the mineral, and limit its consumption. Except for culinary and manufacturing purposes it is little used, the inhabitants trusting to furs and skins for protection from the extreme rigour of their winters. Chinese cosmogonists, drawing on mythology, gravely state, that in one of the Pinking mines, the furnace still exists in which Ninkiver fused stones for repairing holes in the heavens.

**100—Mental Illusion.** H. T.—It arises in the case referred to from the symmetrical arrangement, and might be further illustrated in architectural structures. In these all the wood and stone, howsoever ornamented and carved, have been unshapen in trees and quarries; and all the colours, gilding, and ornamental-work, have sprung from the rudest materials. Combined, however, by rule, they create a sentiment which often governs and misleads the mind,—and without any reason, except in the imagination, a costly temple inspires more homage of the mind than a barn or a mud cottage. It is an illusion of the senses, of which state-craft and priestcraft take very unfair advantages, and they add to the effect by loftiness and expanse, so as to exalt the senses beyond their usual powers. The Egyptians made the most of this mental mistake in the construction of their temples; in which vastness was the chief feature, and the builders of cathedrals, in the middle ages, acted upon the same principle.



**101—Etesian Winds.** H. C.—By Etesian winds, in ancient history, are meant such winds as blow at stated times of the year, from whatever part of the compass they may come.

**102—Clinical.** D. F.—In its literal sense, it means anything pertaining to a bed. Thus a *clinical lecture*, is a discourse from notes taken at the bedside by a physician, with a view to practical instructions in the healing art. *Clinical medicine* is the practice of medicine on patients in hospitals, or in bed, and the term *clini*, was, also, applied by the ancient Church-historians, to one who received baptism on his death-bed.

**103—Lustre.** M. A. C.—It is a general term, expressive of various degrees of light used in modern works on mineralogy. The lustre of minerals is of five kinds,—1st, *splendent*, that is, when in full daylight, the lustre can be seen at a great distance; 2nd, *shining*, when, at a distance, the reflected light is weak; 3rd, *glistening*, when the lustre is only observable at no greater distance than an arm's length; 4th, *glimmering*, when the surface, held near the eye in full daylight, presents a number of shining points; 5th, *dull*, when the surface has no lustre.

**104—The Elements.** T. E.—The ancients considered fire, air, water, and earth, as simple substances, essential to the constitution of all terrestrial beings. This hypothesis, evidently incompatible with modern chemical discovery, may be supposed to correspond, however, to the four states in which matter seems to exist; namely,—1st, the unconfined powers of fluids, caloric, light, and electricity; 2nd, ponderable gases, or elastic fluids; 3rd, liquids; 4th, solids. The three elements of the alchemists—salt, earth, mercury—were, in *their* sense of the word, mere phantasms.

**105—Encaustic Painting.** E. F.—It was a method of painting used by the ancients, the precise mode of executing which is by no means sufficiently explained. From Pliny's account, it seems that the colours were made up into crayons through a medium of wax; and, the subject being previously traced with a metal point, were melted on the picture as they were used. The colours thus not only obtained considerable brilliancy, but the work was also protected from the weather. It was, lastly, well polished. The attempts to revive this art have not been attended with success.

**106—Descriptive Poetry.** G. G.—The great art in this kind of poetry seems to be not to specify every minute particular, but to select the most striking and picturesque circumstances, which would naturally make the deepest impression on the mind of the beholder. We would mention Thomson, as an example of genius consisting almost entirely of description. His influence over the stronger passions is very slight, although some of his episodes in "The Seasons," and scenes in his plays, discover a capacity for giving effect to moderate passion. The eloquent genius of Parnell, too, has produced some beautiful examples of descriptive poetry.

**107—Metaphor.** M. L.—In your reading you ought never to pass a word without understanding the meaning of it. If you do this, what are you reading for? Not certainly for instruction, which ought to be the object of all reading. Metaphor, is a figure founded entirely on the

resemblance which one subject bears to another. It is therefore—almost the same as a simile or comparison, but expressed in an abridged form. For example, when we say of some great minister, that, "he upholds the state, like a pillar which supports the weight of a whole edifice," we make a comparison, but when we say of such a minister that he is "the pillar of the state," we express a metaphor.

**108—Mosses.** C. D.—You will find the study, intricate, difficult, but healthy and delightful. Linnæus has attempted to arrange them according to what he takes to be the signs of fecundation, many of which he acknowledges to be wanting. Hence, in the description of such imperfect plants, it becomes necessary to distinguish them according to their general habit and structure. Their leaves absorb water very rapidly; and, when a dried moss is dipped in water, it very soon resumes the freshness and appearance of life. The internal structure of mosses is entirely cellular. They are found in cool, airy, and moist situations, in woods, upon the trunks of trees, on old walls, and on the roofs of houses. Some of them are entirely aquatic. About 800 species are already known.

**109—The Hygrometer.** D. C.—It is an instrument for measuring the degrees of moisture or dryness of the atmosphere. That of De Luc consists of a very thin slip of whalebone cut transversely, or across the fibres, and stretched by means of a spring between two points. One end is fixed to a bar, while the other acts on the shorter arm of the index of a graduated scale. When the whalebone absorbs moisture, it swells, and its length is increased,—as it becomes dry, it contracts; and the space over which the index moves, by the one or the other of these effects, gives the measure of the expansion or contraction, and the corresponding change in the hygrometric state of the atmosphere. The action of this hygrometer appears to be more uncertain than that of Saussure.

**110—The Pyrrhic Dance.** G. M.—The lines of Byron,

"You have the Pyrrhic dance as yet,  
Where is the Pyrrhic phalanx gone?"

allude to the *Pyrrhica Sattatio*, of the Romans, a species of warlike dance, said to have been invented by Pyrrhus, to grace the funeral of his father Achilles, though this point is involved in obscurity. This dance consisted chiefly in an adroit and nimble turning of the body, as represented in an attempt to avoid the strokes of an enemy in battle, and the motions necessary to perform it were looked upon as a kind of training for the field of battle. This dance is supposed to be described by Homer as engraved on the shield of Achilles. The Suliotes still perform this dance.

**111—The Shakspearean Drama.** T. A.—The Shakspearean drama, properly considered, must be looked on as a miscellaneous compound, in which actors, language, and sentiments, of a character far removed from those of ordinary life, alternate with those of a low and even a burlesque character. There is no tragedy in Shakspeare in which comic scenes and characters are not introduced. There is only one comedy, "The Merry Wives of Windsor," without some intermixture of sentiment approaching to tragic. It continued to be the chief national literature, as well as the fa-

vourite national amusement down to the period of the civil wars, when the opinions and legislation of the prevailing party, put a stop to dramatic representations altogether. During the interval thus created, the old English art was unlearned; and the new drama, on the model of the French, was introduced almost at once on the return of Charles II., and his courtiers from the continent.

**112—Blank Verse.** S. R.—Both blank verse and the heroic couplet, now in general use for grave or elevated themes, are of comparatively modern date. Surrey translated *Virgil's Eneid* into blank verse,—which is the first composition of the kind, omitting tragedy, extant in the English language; and the other measure was but little affected till the reign of Charles II. The verse previously used in our grave compositions was the stanza of eight lines, the *ottava rima*, as adopted with the addition of one line by Spenser, in his *Fairy Queen*, who probably borrowed it from Ariosto and Tasso,—the Italian language being, at that period, in high repute. Boccaccio first introduced it into Italy, in his heroic poem *La Teseide*, having copied it from the old French *chansons*. Tressino is said to have been the first introducer of blank verse among the moderns, about 1503,

**113—Poet Laureate.** M. K.—It is the title given to a poet whose duty it is to compose birthday odes, and other poems of rejoicing, for the monarch in whose service he is retained. The office is at present filled by Alfred Tennyson, the services formerly required being now dispensed with. The first mention of a king's poet in England, under the title of poet laureate, occurs in the reign of Edward IV. *Poeta laureatus* was, however, also an academical title in England conferred by the universities, when the candidate received the degrees in grammar, rhetoric, and versification. The last instance of a laureated degree at Oxford occurs in 1512. Ben Jonson was court poet to James I., and received a pension, but does not seem to have had the title of laureate formally granted him. Dryden held the office of Charles II., and afterwards of James II., by regular patent under privy seal. Nahum Tate, Rowe, Eusden, Cibber, Whitehead, T. Warton, Pye, Southey, Wordsworth, and Tennyson have been Dryden's successors.

**114—Gavel-kind.** P. R.—We think the law is explained in the history you are reading; however, it is a tenure or custom belonging to the lands of Kent, whereby the lands of the father were divided equally, at his death, among his sons; and the land of a brother, dying without issue, descended equally to his brothers. The principal properties of gavel-kind are, that the tenant is of age, to alienate his estate, at fifteen years: that the estate does not escheat in case of an attainer and execution for felony, the maxim being,—

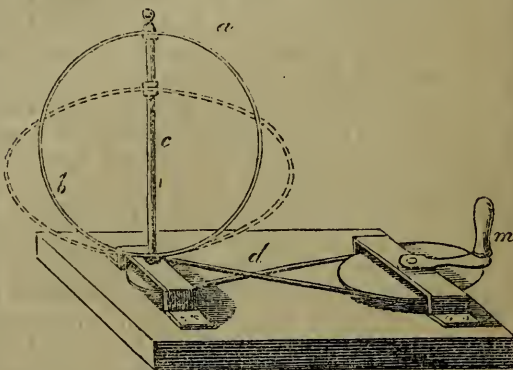
“The father to the bough,  
The son to the plough.”

The wife also shall be endowed of a moiety of the gavel-kind lands, of which her husband died possessed, during her widowhood; and a husband may be tenant, by courtesy of half his wife's lands, without having any issue by her; but if he marries again, not having issue, he forfeits his tenancy. This species of tenure prevailed in England before the Norman conquest,

in many parts of the kingdom, if not throughout the realm; but particularly in Kent, where it still exists, in consequence, as is affirmed, of the Kentish men having submitted upon the express conditions of retaining their peculiar privileges.

**115—Depth of Different Seas.** G. S.—In the neighbourhood of the continents the seas are often shallow; thus, the Baltic sea has a depth of only 120 feet between the coasts of Germany and those of Sweden. The Adriatic, between Venice and Trieste, has a depth of only 130 feet. Between France and England, the greatest depth does not exceed 300 feet, while south-west of Ireland it suddenly sinks to 2,000 feet. The seas in the south of Europe are much deeper than the preceding. The western basin of the Mediterranean seems to be very deep. In the narrowest parts of the Straits of Gibraltar, it is not more than 1,000 feet below the surface. A little further toward the east, the depth falls to 3,000 feet, and at the south of the coast of Spain to nearly 6,000 feet. On the north-west of Sardinia, bottom has not been found at the depth of nearly 5,000 feet. With respect to the open seas, their depths are little known. About 250 miles south of Nantucket, the lead has been sunk to 7,800 feet. In north latitude, at 78 degrees, Captain Ross has exceeded 6,000 feet in Baffin's Bay. But the most astonishing depths are found in the Southern Atlantic: west of the Cape of Good Hope 16,000 feet have been found, and the plummet has not found bottom at 27,000 feet west of St. Helena.

**116—The Centrifugal Force.** C. D.—All the different points of the earth are not equidistant from the axis of rotation, and this force is greatest at the equator, and diminishes as it approaches the poles, acting against gravity, and lessening its intensity. The illustration below will explain how it is that the earth is flattened at the poles. You observe there are two discs,



which revolve horizontally. When the handle *m* is turned it conveys the motion of the larger disc, by means of the string *d*, to the lesser disc, which has the vertical axis *c* fixed in its centre. A spring, *a b*, is fastened by its lower end to the axis, and the upper part can be moved up and down; and, when the machine is at rest, it forms a spherical figure, but assumes an elliptical figure, when the axis revolves rapidly, owing to the centrifugal force acting upon those points most remote from the axis.



**117—*Fabulous Age.*** M. O.—The fabulous age, is that period in the history of every nation in which supernatural events are represented to have happened. The fabulous age of Greece and Rome is also called the *heroic age*.

**118—*Origin of Pasquin.*** E. P.—A mutilated statue at Rome, in a corner of the palace of Orsini, so called after a cobbler of that city, famous for his sneers and gibes, and who diverted himself with passing jokes on all the people who went through the street in which he lived. Hence *pasquinade*, something in the style of Pasquin.

**119—*The Ancients and the Moderns.*** P. C.—The ancients might have loved and rejoiced, as fully as we can, in the shadow of the grove, the coolness and sparkling of the fountain, the purple of the grape, the glow of the sunbeam, all that tended to administer the sense of a *bonheur d'être*, but it seems attested alike by their poetry and art, that they *could* not find more than this in the marvels or beauties of nature, nor read in her aspect, as we can, a revelation of power and love.

**120—*Water and Mercury.*** E. G.—Water and mercury are the most perfect liquids; others are more or less viscous. The particles of liquids move and press equally in all directions, those of solids, only downwards. They press on any surface, as the base of the distance to the upper surface of the fluid. The pressure is distinct from the weight of the mass. It is as the height whatever the base. A cone and cylinder of equal height have the same pressure.

**121—*Mediæval Structures.*** E. U.—No. Many of the mediæval structures are chiefly serviceable as things for criticism bearing not less on their defects than their beauties. The old Norman structures, especially, are of very mixed quality, and it is painful to see their manifest defects elaborately perpetuated by the graver as "precedents" for error. That which is interesting in the *history* of architecture is not always worthy in respect to the future progress of design. This confounding of antiquarianism with art is the vice of the present day.

**122—*Combustibility of the Diamond.*** L. F.—That the diamond is combustible was first proved by the Florentine Academicians, in 1694, who found that when exposed to the heat of the sun concentrated in the focus of a large lens, it burned away with a blue lambent flame. The *products* of its combustion were first examined by Lavoisier, in 1772, who showed that when it was burned in air or oxygen it produced carbonic acid. Subsequent experiments have shown that nothing but carbonic acid is thus formed, and hence it is proved that the diamond is charcoal or carbon in a pure and crystalline form.

**123—*Saint Pierre and Delavigne.*** S. R.—No. Bernardin de Saint Pierre, the author of *Paul and Virginia*, is looked upon in France with the same general affection as among us is Oliver Goldsmith, whom he far transcended in all the attributes of manhood. Casimir Delavigne, on the other hand, the frosty dramatist of the Restoration, is as little remembered there as are the tragedies of the late Mr. Sheil here. Both were natives of commercial Havre, and that busy town turned out lately with its officials and whole population to inaugurate the erection of statues (from the well-known chisel of David of Angers) to these its two literary townsmen.

**124—*Sophocles.*** T. M.—He died about 407 years before Christ. Only seven of a hundred of his tragedies have survived to our time. The portrait alluded to is of the feelings of a good wife, and has been rendered in the following lines:—  
Faithful—as dog, the lonely shepherd's pride;  
True—as the helm, the bark's protecting guide;  
Firm—as the shaft that props the towering dome;  
Sweet—as to shipwreck'd seamen land and home;  
Lovely—as child, a parent's sole delight;  
Radiant—as morn that breaks a stormy night;  
Grateful—as streams that in some deep recess,  
With rills unhop'd the panting traveller bless.

**125—*Young Authorship.*** G. F.—Your ambition to be an author is praiseworthy, provided its aim be to instruct or improve mankind and leave the world better than you found it. To do this effectually there are two requisites which are absolute; namely, *labour* to acquire knowledge, and *practice in writing*, to enable you to diffuse that knowledge through the medium of print. Without entering steadily and systematically upon the former you will never get knowledge worth the name, and without strenuously pursuing the latter, your knowledge will be so circumscribed in its circulation that it will be useless to almost everybody but yourself.

**126—*The Tides of the Ocean.*** D. H.—The observation, hitherto made on the *tides of the ocean* have been insufficient to furnish such a connected knowledge of the subject as would enable us to follow the course of the tide over any considerable portion of the ocean; and in the opinion of persons most competent to judge, it is only by systematic observations, specially directed for the purpose, that this connected knowledge is likely to be obtained. The recent researches of Captain Beechey, which have given a new and unexpected view of the tidal movements of the ocean, show how much yet remains to be learned respecting the tides even for the practical purposes of navigation.

**127—*Apprenticeship.*** M. S.—In most professions of the liberal kind, there is in England no contract for apprenticeship; the pupil or learner, pays a fee, and has the opportunity of learning his teacher's art or profession, if he pleases. Thus a man who intends to be called to the bar pays a fee to a special pleader, a conveyancer, or an equity draughtsman, and has the liberty of attending at the chambers of his teacher, and learning what he can by seeing the routine of business and assisting in it. But he may neglect his studies if he pleases, and this will neither concern his master, who can very well dispense with the assistance of an ignorant pupil, and get the money without giving anything for it, nor the public.

**128—*Pompeii and Herculaneum.*** D. C.—No. Pompeii was destroyed by showers of ashes, but Herculaneum by hot mud, on which six streams of lava have since accumulated. They had recently been destroyed by an earthquake, and were rebuilding. In the barracks of Pompeii were found the skeletons of two soldiers fastened by chains, and in the vaults of a country-house were seventeen persons, among which was a perfect cast of a woman and a child in her arms, the bones with a gold chain and rings only remaining. Fishing-nets are abundant in both cities. A loaf and various condiments were found, and boxes of pills at an apothecary's. The Papyrei

of Pompeii were illegible, but those of Herculaneum, though charred, may be deciphered.

**129**—*How to get stocked with words.* P. A.—It is only by a constant exercise of the suggestive faculty that it can be so invigorated as to remove altogether the difficulty of recalling the right word at the right time. On this account the use of a gradus is often forbidden to those who are learning the art of versification. An attentive study of classical authors is considered the only sound method of acquiring a *copia verborum*, and incessant practice the only means of attaining to a facility in using it when acquired. A crutch may be useful enough to a lame man, but the sooner he can do without it the better. Artificial support is but a poor substitute for natural strength,—and it becomes positively injurious when it is made to stand in the way of that active exertion which is essential to the increase of strength.

**130**—*The Incrustations of the Earth.* A. L.—In estimating the space of time occupied in the formation of the sedimentary crust of the earth where it exists to the thickness of a few thousand feet, we need only assume the deposits of the Nile as a criterion. These deposits have been found to accumulate at the rate of four inches in a century; how vast must be that antiquity since the sedimentary incrustations of our earth first took their rise. The decomposition of earlier crystallized formations occurring while these (primary) formations were in a state of incandescence immediately below the outer surface, they formed the lower strata of the Neptunian sediment; appearing, as we now discover them, in the shape of micaceous and argillaceous slate; and afterwards covered by calcareous matter held in solution by the water above them.

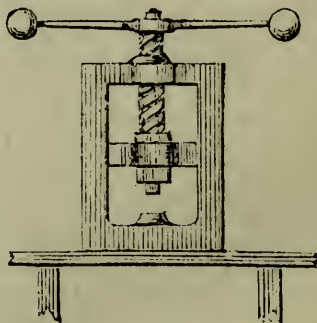
**131**—*Education and Crime.* T. E.—We do not mean to say that education would blot out crime, but there can be no doubt of its beneficial nature; and we have hopes that our Legislature is beginning to discover that education is less expensive, and more honourable to a nation, than huge machinery in the shape of prisons, transport ships, and penal colonies, for the punishment of crime. It would be extremely interesting to compare the amount of crime with the extent of education in each country, and to be enabled to mark the extinction of the former by the growth of the latter. A remarkable instance has lately shown that crime is rife where education is neglected. In the borough of Stockport, possessing a population of 85,000, which has just made itself conspicuous for its atrocities, the reports of the School Inspector state that only 350 children were at school in the whole borough.

**132**—*French Literature.* C. E.—Politics may be centralized in France, but certainly literature is not so; and the French provinces contribute a large proportion of what is most interesting in the current archaeological and even historical literature of the country. This, probably, is due chiefly to the number of men of superior intelligence and cultivation, who are employed as instructors in the national colleges which are spread over the face of France. Something of it, too, is due to the various Provincial Academies with their own intellectual activity, and that which they excite by the offer of prizes for the best essays on given subjects. Who forgets that it was a prize offered a century ago by the Academy of Dijon

for an essay on the question: "Have morals been benefited by the revival of science and letters,"—that produced Jean Jacques Rousseau's first famous composition—on the preferability of savage to civilised life?

**133**—*The Magnitudes of Luminous Objects.* G. U.—No, the visible magnitude of luminous objects, as the sun, the moon, or the planets, are probably at all times greater than the geometrical magnitudes, on account of the imperfection of the eye. If a spectator who is very short-sighted, look at the full moon, he will observe that the visible image is made up of a great number of moons surrounding, and partly overlaying one which appears to be in the centre, so that the diameter of the compounded image, is more than double the simple diameter of the moon. A single image of the moon is apparently restored when such spectator places before the eye a concave lens of a certain curvature, but an enlargement of the disc still exists to a certain degree, probably, even for those eyes which are considered as in the most natural state.

**134**—*The Coining-press.* A. R.—The best explanation which we can give you of a coining-press is to show it you in a diagram. This machine is said to have been invented by Briot, the mint master to Louis XIII. of France, and is an excellent example of what is called the concentration of force. A man causing the screw to descend with great power, makes a good impression of



the die upon the metal at one stroke, by whirling the balls at the end of the horizontal bar.

**135**—*The Vegetable World.* M. S.—In the vegetable world there is a ground type (*grand type*) which characterizes the outward structure of all plants such as a perpendicular axis with radii extending out towards their periphery. It was Goethe who first drew attention to the phenomenon that all the peripherian forms of plants, all the radii of the stem and of the flower, were in their typical sense identical, and only differ some minor points and arrangement. Upon this fundamental scheme (*grand schema*) has been built a superstructure of 60,000 various forms and varieties of vegetable life. "affording us a truthful picture of the all-creative fancy of Omnipotence, in striking contrast with the poverty of human art, the productions of which, be they as numerous as those of a Rubens, or as ideal as those of a Raphael, always retain some certain characteristic, betraying the pencil of the master after his name has been effaced from the canvas." Vegetable life and atmospheric changes, accompanied by a discharge of those noxious gases which are incompatible with animal existence, were the precursors of the higher forms of organized creatures, whose appearance we regard as synchronous with the approach of the tertiary epoch.



**136—Why Water Boils.** U. A.—Water boils because the fire beneath fixes the atoms of oxygen, and these first impart their motions to the combustible, and then by this to the bottom of the vessel, and by it to the fluid. The heat in the fluid is a condensation of the oxygen in the air as fixed by the combustible.

**137—Rusty Hats.** C. L.—The mode in which you have related your misfortune, and the monologue which you have poured forth upon the change which the colour of your hat has undergone, have been received; and we are glad to inform you, that the marble immobility of our heart, has enabled us to peruse both with a dry eye. The cause of the change is, the muriatic acid from the sea disturbing the gallic acid in the black dye.

**138—The Natural.** A. R.—The natural is the highest attainment at which art can arrive. Raffaele's pictures, in their colouring and atmospheric relief, so much resemble Nature, that they do not strike in a gallery like others with more glare and relief. It is the same with Correggio, and is the same with all perfect compositions in language; beauties are only discovered by those who know the difficulty of being perfectly natural.

**139—Booby.** G. A.—We hope you are not one that you are induced to ask whence the term is derived. However, there is a bird called a *booby* of the Pelican tribe. It constitutes the subgenus *Sula* of Brisson, and takes its name from the excessive stupidity with which it allows itself to be attacked by other birds, particularly the frigate birds, which force it to yield up the fish it has captured; from this, the term has been adopted in our schools to designate a very stupid boy.

**140—Chloral.** A. M.—It is a chemical substance, lately described by Liebig: under this name. It consists of chlorine, carbon, and oxygen, and may be called a chloride of carbon. It is a limpid colourless liquid, similar in odour and appearance to the oily fluid which chlorine forms with olefiant gas; but in density, volatility and composition, it is very different. It is formed by passing *chlorine into alcohol*, from the first syllables of which words the name is formed.

**141—Popular Amusements.** J. A.—We do not think so, but on the contrary consider the current amusements of London and large cities fatal to extensive intellectuality. A few years ago we were enabled to judge of the reading of London from the fact, that in three parishes of Westminster, consisting of 101,000 inhabitants, there were thirty-eight small libraries, containing each about five-hundred and fifty volumes of novels, romances, and other kinds of light reading, and fifteen large ones stocked in nearly the same manner.

**142—Dialectics.** N. F.—Zeno was the inventor of the logic so celebrated as *Dialectics*. Not Zeno the Stoic, but Zeno of Elea. He is also said to be the first who set the example of writing in prose. His system may be defined as, "A refutation of error by the *reductio ad absurdum* as a means of establishing the truth." The truth to be established in Zeno's case was the system of Parmenides which had been conceived by Xenophanes, and there only remained for Zeno the task of fighting for and defending it; which task, as Cousin says, he admirably fulfilled.

**143—The Novel.** M. C.—The decline of litera-

ture in England has been accelerated, or caused, perhaps, by a passion for novel-reading, which by absorbing patronage, deprives all other studies of their due reward. It resembles the Roman literature in the decline of the Empire; and for some years past, few books but novels have paid their expenses. A good novel yields its author from £300 to £3,000; while Dr. Johnson's high price for his Dictionary was but £1,575. A novel written in two months, will yield its author £300 or £500 as a current speculation.

**144—Gaseous effects upon Air.** A. B.—Decidedly so. Air is rendered very deleterious by gases and vapours generated in the earth. In a certain valley, in the Island of Java, carbonic acid is thrown out in such quantities, that no animal can there exist, and birds flying low drop dead. At Fahlán in Sweden, noted for copper mines, the mineral exhalations so affect the air, that silver in the purse becomes discoloured. In Carniola and Campania, the air is impregnated with sulphur, and it has also been found to contain arsenic. That such poison arises from subterranean action may be inferred from the destruction of millions of fishes.

**145—The Aurora Borealis.** M. E.—The first notice of *Aurora Borealis* in England was on March 6th, 1716. Why then and since, seems inexplicable. There is no doubt, however, that it was one of the natural phenomena by which ancient priestcraft played on superstition, and constituted the fiery swords and signs in the heavens, which often led to loss of battles, and revolutions among the Greeks, Romans, and Asiatics. It is seldom seen in middle Europe, but is almost constant in the Arctic and Antarctic regions, covering the whole heavens, and eclipsing by its splendour the stars and planets. It is accompanied by a rustling snapping noise, and taken altogether is often terrific. Its height is undetermined; some say seven others a hundred miles.

**146—The Insurance of Fame.** T. S.—You may and you may not be wrong; much, if not all, will depend upon your mode of handling the subject and the originality you evince. It should never be forgotten by all aspirants to the temple of fame, that it is the subject matter only and original ideas, independent of theories and fancies, that assure fame; not flippant, time-serving works, or such as merely humour the taste of the day. The only permanent associations are those connected with nature, not in speculations, but in novel facts. On this account Aristotle and the ancient astronomers live with their subjects. So Tycho Brahe, Galileo, Kepler and Newton. Nothing has a chance of permanent fame, which does not gratify human nature, whether Chinese, Hindoo, Turkish, Russian, English or American, for every nation passes through the mental phases of all nations.

**147—Ancient and Modern Statuary.** S. M.—The great difference between ancient and modern statues does not consist so much in the faces (though here, too, it shows itself, since the moderns take the matter more easily, and make their faces of a more general character, and with less individuality), as in the play of the muscles. If any one wishes to see the difference in a very striking way, he must examine ancient and modern statues together by torch-light. Such a study affords great pleasure and enjoyment; the ancient statues then seem living, and an endless



variety of living muscles appears on the surface; modern statues do not possess this transparency; they are smooth, and there is no life in them; they seem dead, even when they are the productions of great masters. The bas-reliefs of Thorwaldsen may be placed by the side of those of ancient sculptors, but not so his statues.

**148—Niebuhr.** T. F.—No. Niebuhr was essentially a destructive. He rejoiced in the overthrow of established beliefs. He was never so happy, so thoroughly in his element, so energetic, as when he was making war upon some story which all the world fondly believed, or rather accepted with blindness of faith, because it was so pretty and so poetical, that it *ought* to be true. Niebuhr had no compunctions on the score of beauty. If it was a fable, down with it. The object of knowledge is *truth*, not poetry—instruction, not amusement—and, whatever is not true, cannot be wholesome, or even harmless; one untruth in history, as in morals, leads of necessity to others. We receive the first, and then are compelled to mould all other facts to that falsity. Besides, there is no advantage in the belief of fable; we may still enjoy it *as* fiction, only remembering always *what* it is, and taking care not to mistake it for truth.

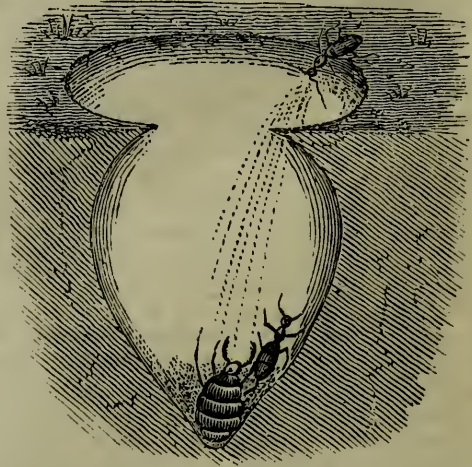
**149—Population of the Globe.** M. E.—The population of the globe for the two last centuries, was estimated at one thousand millions; but modern calculations in 1825 reduce it to about 700 millions. If, then, a doubling took place every twenty-five years, according to the theory mentioned the population in 1800 could have been but three hundred millions. In 1775, but one hundred and fifty millions. In 1750, but 75 millions; and in the time of James I., when public writers estimated the population at a thousand millions, there ought to have been only Adam and Eve in the Paradise of Moses. Comparing deaths with births, doubling under favourable circumstances, really takes place in only about 260 years. But it may be doubted whether, in the aggregate, the earth was not as populous in the age of Augustus. At all events there is no date to draw an accurate deduction between any two remote periods.

**150—The Polar Ocean.** A. B.—It is not yet determined. The analogy of the configuration of the land and sea on the north of the continents of Asia and America has for some time past caused an opinion to be entertained that the sea on the north of the Parry Islands might be as open as it is known to be throughout the year in the same latitude on the north of the Siberian Islands. The expectation that Wellington Strait might, as a continuation of Barrow's Strait, prove a channel of communication from the Atlantic into that part of the Polar Ocean, has been considerably strengthened in the last year by the discoveries which we owe to the hardihood and intrepidity of our merchant seamen. The access to the Polar Ocean, and the degree in which it may be navigable for purposes of discovery or of scientific research, are amongst the few geographical problems of high interest which remain to be solved; and we may confidently look for a solution, in the direction at least that has been adverted to, by the Expedition which has been despatched, under Sir Edward Belcher, to follow up the discovered traces of Sir John Franklin's vessels.

**151—Fermentation.** B. N.—There are three

kinds of fermentation, the venous, acetous, and putrefactive, which generally succeed each other. The venous fermentation arises from the saccharine principle in sugar or malt. When sugar only, yeast is necessary. At 32 degrees it stops; at 50 degrees is slow; at 70 degrees, becomes acetous. The gas disengaged is carbonic acid, carbon being carried off, and the atmospheric air not being absolutely necessary. Flavour arises from essential oils, and intoxicating properties from the alcohol. Thenard thinks that the carbon of yeast abstracts the oxygen, and then the hydrogen and carbon of the sugar combine with the hydrogen and nitrogen of the yeast. The *acetous* follows, and the presence of air is necessary; and chemists conceive that the oxygen of the air combines with the carbon of the venous fluid. The temperature rises to 85° or 90°. The putrefactive affects all animal and vegetable substances. Air, heat, and moisture are necessary. Vegetables give out hydrogen and carbon, and under water hydrogen only, and the residuum is charcoal; but in air, the carbon becomes carbonic acid. Animal substances evolve the same and ammonia, also sulphur and phosphorous in their unpleasant odours.

**152—The Den of the Ant-Lion.** B. U.—It presents the appearance of a conical hole, rather more than two inches deep, gradually contracting to a point at the bottom and about three inches wide at the top. The accompanying section gives a fair idea of its appearance. It is



begun by the insect-lion tracing a circle on the sand, like the furrow marked out by the founder of a new city, or, to speak more appropriately, by the builder of a new house. He then places himself in the centre of the circle, thrusts the hind part of his body under the sand, and using one of his fore-legs as a shovel, loads his flat square head with sand and throws it over the outside of the intended opening, with a jerk sufficiently strong to carry it to the distance of several inches. He again traces a new circle and forms another furrow walking backwards, and repeating the same process, and thus does he perseveringly go on until his den is completed. No obstacle that insect exertion can surmount will intermit his labours, for his courage, energy and perseverance seem to be indomitable.



**153—Life.** A. T.—We hope you are not like those who find the day too long, and think life too short; for, short as life is, these find it long enough to outlive their characters, their constitutions, and their estates.

**154—Elasticity of the Mind.** Y. R.—There is an elasticity in the human mind capable of bearing much, but which will not show itself until certain weight of affliction be put upon it. Although your simile is a good one, we think its owners may be better compared to those vehicles whose springs are so contrived that they get on smoothly enough when loaded, but jolt considerably when they have *nothing to bear*.

**155—Advice.** T. S.—To decline all advice, unless the example of the giver confirms his receipts, is about as sapient as if a traveller were to refuse to follow the directions of a finger-post, unless it drew its one leg out of the ground, or, rather, hopped after its own finger. No man can talk up to the precepts he is capable of laying down, therefore we would advise you, never to put your ears against good counsel, come from where it may.

**156—Musical Stenography.** P. A.—All we can say about it is that a Congress of German Stenographers has just been held at Munich, which was attended by sixty members of the profession. One of the members, M. Baumgartner, of Vienna, described a system of musical stenography, invented by him, by means of which, as he said, the most complicated musical compositions can be written down during their execution. Trials of the system were made in presence of the members and of many musical artists,—and they are said to have succeeded perfectly.

**157—Bombay.** E. R.—Bombay has always been considered the grave of Europeans—the *terra Leone* of India—owing to the high tides which rise, and divide the island into six or seven parts, the water forming a continual morass till the next high tide, leaving pestilential miasmata; fortunately, however, means have been taken to revert the influx of the tides, and the best results have followed, in a sanitary point of view. In Great Britain the mortality is as one in forty-even; and it is represented in the Tables to be now only one in twenty in Bombay, though the view is thought to be too favourable.

**158—Railroad through Asia Minor.** P. S.—Yes; but it is said the better route through Asia Minor would be along the coast of the Sea of Marmora, rather than through the mountains of the interior of Anatolia, which it would be next to impossible to surmount. The Turks, who are just now are very much alive to the great importance of commerce, are engaged in opening a great commercial road from a port on the Black Sea to Sivaze, a town in the centre of Asia Minor,—and the completion of this undertaking, will, no doubt, be one of the greatest inducements to the commencement of the projected railway. Taking the matter all in all, it is perhaps difficult to imagine any country better adapted for colonization or improvement. At present, the country could not be said to be safe from the predatory Arabs, but the Turks and agricultural Arabs are well disposed. The road from London to Bombay is 5,500 miles; for 2,600 miles of this there is already a railway, and works could be carried on cheaply in Asia Minor from the facility

of procuring labour. The capital required is calculated at twenty-two millions.

**159—Guano Producers.** P. D.—Along the sea-board of Peru and Bolivia, within the Tropic of Capricorn, countless numbers of aquatic fowls exist, which live on fish, and whose excretions are exceedingly fertilizing. In some localities, the number of guanais is enormous, so that when alarmed by discharges of fire-arms, or otherwise, they rise from their nesting-places in such masses as cannot be supposed by those who have never seen these birds darkening the air like a cloud. Guano-producers change their habitation when continuously disturbed, but they do not permanently leave a locality which has long been frequented by them, in consequence of a temporary alarm; for, in such a case, they soon return to their old haunts, and totally abandon them only when teased by lasting annoyances. The ocean on the west coast of South America, within the tropic, teems with fish, the quantity seeming exhaustless, and guanais equally abound; so that their eggs are gradually accumulating somewhere either on or off that desert land, and now has become an object sought after, not only by the Peruvian mountaineer, but by the merchant, shipowner, and statesman.

**160—Conciseness of Truth.** G. C.—No disorders have employed so many quacks as those that have no cure; and no sciences have exercised so many quills, as those that have no certainty. Truth lies in a small compass; and if a well has been assigned her for a habitation, it is as appropriate from its narrowness as its depth. Hence it happens that those sciences that are capable of being demonstrated, or that are reducible to the severity of calculation, are never voluminous; for clearness is intimately connected with conciseness, as the lightning, which is the brightest thing, is also the most brief; but precisely in proportion as certainty vanishes, verbosity abounds. To foretell an eclipse, a man must understand astronomy; or to find out an unknown number by a known one, he must have a knowledge of calculation; and yet the rudiments that enable us to effect these important things, are to be found in a very narrow compass. But when we survey the ponderous and voluminous folios of the schoolmen and the metaphysicians, we are inclined to ask a very simple question:—What have either of these plodders done, that has not been better done by those that were neither?

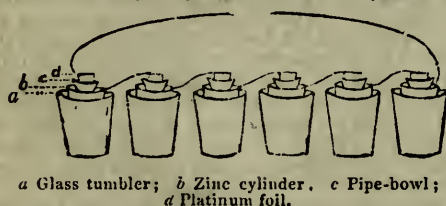
**161—The German Races.** E. F.—Dr. Latham has endeavoured to thread the maze of rumours about the German races, which, rather than any exact reports, made up the sum of knowledge possessed by Tacitus and his contemporaries of the names, sites, and habits of the Transalpine races. He labours to show how far the Teutonic and how far the Celtic element prevailed from the Zuyder Zee to the confines of Gaul and Illyricum. Germany Proper—so far as that designation can be applied to the floating population of Central Europe in the second century of our era—he restricts to narrower limits than most of his predecessors have assigned to it. He shows, with much learning and probability, that the collision and interweaving of the Kelts and Teutons have been hitherto much under-rated. He traces the principal leagues of these races, and proves how often merely conventional names for casual or political combinations have been mistaken for



proper generic appellations. He has also displayed great skill and learning in detecting the various phases which at different eras the German tribes have presented, and how frequently geographers have described their temporary as their permanent aspects.

**162—Glasgow, in 1852.** F. A.—It is divided, like Edinburgh, into Old and New Town, and although it cannot boast of a romantic site, or of venerable antiquity equal to the other, still its older portions present features not less picturesque, whilst its noble cathedral is a monument of architecture to which its inhabitants point with justifiable pride. The modern division of Glasgow conveys an exalted idea of the wealth of its citizens, and of that love of architectural magnificence which may be said to be characteristic of our northern compatriots, whilst the beauty of the material of which the Scottish cities are built attracts the admiration of Londoners accustomed to brick and compe. Besides this advantage in material, and their durable construction, many of the buildings in the classic style exhibit great merits in the design, although it must be said that others are devoid of it altogether. In Gothic architecture, however, the Scotch, particularly in the west, appear to have absolutely no idea whatever of the proper nature of an edifice dedicated to the service of religion. We believe the contrast between England and Scotland is in this respect infinitely in favour of the former, the English architects having left their Scottish brethren immeasurably behind in ecclesiastical design.

**163—Galvanic Battery.** U. F.—Several friends have inquired how to form a good, cheap, and powerful galvanic battery, and we believe no method to be more available than that on Mr. Grove's principle, first given by Dr. Golding Bird. "Procure the bowls of six tobacco-pipes, and stop up the holes, left by breaking off the pipes, with sealing-wax. Place on the table six small tumblers, each an inch high, like those used by children as toys; place in each a cylinder of



amalgamated zinc, let a pipe-bowl rest in each cylinder, and place in every one a slip of thin platinum foil, one and a quarter inch long and half an inch wide, connected at the zinc cylinder by platinum wire; fill the pipe-bowls with nitric acid, and the tumblers with dilute sulphuric acid, and an energetic current of electricity will be set free,—capable of rapidly decomposing water, igniting wire, charcoal points, &c.

**164—The Productive Industry of Paris.** G. A.—Mr. Porter is the best authority. He says that the total number of workmen employed in 1847 was 342,530, which fell, in 1848, to 156,125; being a diminution of 54 per cent. The chief falling off was in furnishing, where the reduction was 73 per cent., and the least was in the preparation of food, which only fell off 19 per cent. The latest value of the productions of Parisian

labour in 1847, was £58,545,134, and in 1848 only £27,100,964. Although the falling off of employment in the preparation of food was not great, that in consumption was very remarkable. The quantity of flesh-meat consumed in Paris in 1847 was 150lb. per head; in 1848, it fell to 87½lb. per head. After affairs settled down again, it rose in 1849 to 146lb. per head, and in 1850 reached 158lb. per head. The difference between 1847 and 1850 is partially to be attributed to the increase of population. The statistics on the degree of instruction found among the workmen is very interesting. Out of the entire number of workmen, 147,311, or 87 per cent., could read and write—Out of 86,617 women, 68,219, or 79 per cent., were able to read and write. The rate of weekly wages was given on an average as follows:—Tailors, 20s. 2d.; butchers, 19s. 7d.; jewellers, 31s. 9d.; bakers, 19s. 7d.; shoemakers, 16s. 6d.; carpenters, 27s. 4d.; cabinet-makers, 20s. 3d.; masons, 18s. 9d.; confectioners, 21s. 9d.; milliners, 20s. 3d.; laundresses, 12s. 3d. It was found that 950 women earned less than 6d. per diem; 27,452 males and 100,050 females earned 6d. to 2s. 5d.; 157,216 men and 626 women earned 2s. 5d. to 4s.; and 10,393 more than 4s.

**165—The Lake of Haarlem.** T. A.—It is quite true that the Lake of Haarlem has been nearly expelled from the territories on which it had seized in spite of Dutchman and Spaniard. In the year 1539, while the people of the district were groaning under the oppression which afterwards drove them into the insurrection now considered one of the noblest up-risings of the world,—the North Sea broke over the artificial dams and the triple ridges of sand formed by the action of wind and tide on that stormy coast, and showed the inhabitants how to isolate their cities and cut off a besieging enemy:—a lesson afterwards turned to effective account by them at Leyden and elsewhere. But the invasion of the water brought horror and desolation into the fertile flats of North Holland. Twenty-six thousand acres of rich pasture land, with meadows, cattle and gardens, were covered by the waves which would not ebb:—and the village of Nieuweinkirk was submerged, and all its inhabitants were lost in the tremendous calamity. More than two centuries elapsed before any one began to dream of recovering this vast estate; and then, although the lake was only six feet in depth, the recovery was long believed to be impracticable. Again and again the project has been started since the present century came in. In 1819 a scheme was submitted to the King for the drainage, and approved,—but it led to no result. Even as late as the session of 1838, a motion for the same purpose was rejected by an immense majority in the Dutch House of Representatives. But as the engineering science of the age grew more daring and confident, even Dutch phlegm gave way, and the works were commenced. They have been long in progress,—and it is now reported that the task is near its final accomplishment. The remains of the unhappy village of Nieuweinkirk have been found, with a mass of human bones, on the very spot where the old charts of the province fixed its site. In a few more weeks it is believed that the Lake of Haarlem, famous for its fishing and its pleasure excursions, will have become mere matter of record, existing only in the page of history.



**166—Enamel.** P. U.—It is made of powdered glass, oxide of lead and tin, and salt of tartar, with coloured substances.

**167—Rosicrucians.** D. F.—This name was assumed by a sect or cabal of hermitical philosophers, who first appeared in Germany, as is generally asserted, in the fourteenth century. They made great pretensions to science, and to be masters of many important secrets, particularly that of the philosopher's stone. The name is derived from the *ross*, dew, and *crux*, cross—dew, the most powerful dissolvent of gold, according to these fanatics, and cross the emblem of light.

**168—The Samiel.** E. F.—It is a hot noxious electrical mud, which passes over the sandy deserts of Arabia and Africa. It moves with the space of lightning, and passes for a few minutes in narrow currents. It occasions, as is reported, instant death to every man or beast happening to face it; and it is said that it so decomposes them that their limbs fall asunder. The approach of it is indicated by a thick haze in the horizon; and travellers, if they have time, throw themselves on their faces with their feet towards it till it is passed. Hewlett thinks that it was a Samiel that destroyed the army of Sennacherib, and Manetho concurs with him.

**169—Commercial Value of Literary Men.** P. C.—As a proof, you may take Sir W. Scott. The various places in Scotland, which his writings have made classic ground, and to which he has drawn public curiosity, are yearly visited by crowds of tourists. In consequence of this, villages have been enlarged, hotels have been built, roads have been opened and improved, lines of steamboats and coaches established, and a great number of operatives employed. And so it is universally: the places which great men have celebrated by their writings or their deeds, or where they have only left their graves, become places of everlasting interest. Stratford-on-Avon will for ever be indebted to the grave of Shakspeare, Dryburgh to the grave of Scott, and Melrose, to the pen which wrote "The Lay of the Last Minstrel," and "The Lady of the Lake."

**170—Saxon Architecture.** B. C.—We know that it has been asserted that the Saxons had no majestic architecture; that their churches, and abbeys, and monasteries, were constructed almost entirely of wood, without arches, or columns, aisles, or cloisters, and that there was no grandeur or beauty in the edifices of England, until after the Norman Conquest. These assertions, however, are theoretical, for the abbey built at Ely by the Saxon bishop Ethelwald, was a stately stone edifice, vast in its dimensions and richly ornamented in its details. Round-headed arches rested upon rows of massive columns; the roof of the church and the roof of the great hall of the abbey were arched and towering; and high above all a tower or steeple shot into the air, to serve as a landmark throughout the flat fenny country, and a guide to such as might lose themselves among the snares and the labyrinths of the willow forests.

**171—Peter the Great.** A. G.—Yes. Perhaps no monarch ever deserved the title of great so much as he. The term is not only applicable to the powers of his mind, but to the effects which that mind accomplished: and of these last, it is to be

remarked, that none have passed away, but all have remained permanent and productive. Alexander the Great, Charles the Great (Charlemagne), and Napoleon *Le Grand*, were all great, and merited the title if considered in a warlike sense, but the empires of all three crumbled to pieces. After moving everything they established nothing. The reason of this is obvious. They based their empires upon the power of the sword, but Peter based his upon the moral strength of knowledge and civilization. The code of laws which goes by his name is the only permanent monument of his power, which Napoleon has bequeathed to France. Where he applied his ability to the real advancement of civilization, the traces of his career were not to be effaced by the changes of rulers or of opinions.

**172—Equivalent Numbers of the Elementary Bodies.** G. A.—Among the subjects of chemical inquiry which may well deserve the attention of a combination of philosophers, perhaps few could more usefully occupy their joint labours than the revision of the Equivalent Numbers of the Elementary Bodies. This is a task which must necessarily require the co-operation of several properly qualified individuals, if it be accomplished within anything like a reasonable period of time. Most of the Numbers now in use depend upon experiments performed by Berzelius, at a time when the methods of research then known were inadequate, even in such hands, to determine these constants with an accuracy sufficient for the wants of science at the present day. So much has this been felt to be the case, that many of the most accomplished chemists now living have undertaken extensive and laborious, though isolated, researches upon the combining quantities of some of the most important elements. But much more than has been already performed still remains to be done.

**173—Terrestrial Magnetism.** H. L.—Yes. But we recognize in terrestrial magnetism the existence of a power present everywhere at the surface of our globe, and producing everywhere effects indicative of a systematic action; but of the nature of this power, the character of its laws, and its economy in creation, we have as yet scarcely any knowledge. The apparent complexity of the phenomena at their first aspect may reasonably be ascribed to our ignorance of their laws, which we shall doubtless find, as we advance in knowledge, to possess the same remarkable character of simplicity which calls forth our admiration in the laws of molecular attraction. It has been frequently surmised,—that a power which, so far as we have the means of judging, prevails everywhere in our own planet, may also prevail in other bodies of our system, and might become sensible to us—in the case of the sun and moon particularly—by small perturbing influences measurable by our instruments, and indicating their respective sources by their periods and their epochs. As yet we know of neither argument nor fact to invalidate this anticipation; but, on the contrary, much to invest it with a high degree of probability.

**174—Sensibility of touch in the Blind.** M. F.—It arises from practice and the habit of association between the touch, memory, and judgment. Stanley the organist, and many blind musicians, have been the best performers of their time; and the blind discriminate sounds at a distance with infinitely greater precision than persons who



depend on their usual organs. Miss Chambers, a schoolmistress at Nottingham, could discern that two boys were playing in a distant part of the room, instead of studying their books, though a person who saw them and made no use of his ears could not perceive that they made the smallest noise, and in this way she kept a most orderly school. So Professor Saunderson could, in a few moments, tell how many persons were in a mixed company, and presently discriminate their sexes by the mere rustling of their clothes. Stanley, and other blind persons, played at cards by delicately pricking them with a pin. A French lady could dance in figure-dances, sew tambour, and thread her needle. The ear, too, guides as to distance, by reflection of sound; and not very long ago a blind man in Derbyshire was a surveyor and planner of roads. When a sense is wanted the others are cultivated with care to make up the deficiency as far as possible.

**175—Lotteries.** D. M.—This species of gambling is said to have been invented by the Romans, who resorted to it rather as a means of amusement than of gain. It has been prevalent, at times, in most of the countries of Europe, where it has been used, under the sanction of Government, for strictly money-making purposes. The earliest English lottery of which we have any record, was drawn in 1569, and the proceeds were devoted to repairing the harbours and other public works of the kingdom. The prizes of this lottery consisted chiefly of plate, and 400,000 tickets were sold at 10 shillings each. In 1612 a public lottery was drawn for the benefit of the English colonies; and soon after, private speculations of this kind began to increase so fast, many of which were founded on the most fraudulent principles, that Parliament was obliged to suppress them as common nuisances. The public lotteries, however, were continued, under license of Parliament, down to 1823: and Government frequently availed itself of this means, to raise money for various public works, of which the British Museum and Westminster-bridge are well-known examples. In France, state lotteries were abolished in 1836. In several of the German states we believe they still exist.

**176—The Raw Material.** S. A.—The raw material used by industry for the production of useful objects, doubtless forms the basis of manufactures, but possesses a fluctuating value, in relation to that of the object into which it is converted. In the successful prosecution of manufactures, apart from the influence of mere capital and labour, two elements are involved, each forming a factor which, in a competition of industry, may be made to assume very different values. The first element is the raw material; the second, the skill and knowledge used in adapting it to the purposes for which it is designed. Thus in America cotton is indigenous, and consequently cheap: and fuel, the other raw material employed in its conversion to a textile fabric, is not expensive. In England the same cotton is much dearer; but the fuel may be assumed to be equal in price. The competition between the two countries, in respect to calico, resolves itself into the necessity that England, to overcome the disadvantage of the greater cost of the raw material, must infuse a greater amount of skill and knowledge into the processes employed in its

adaptation to useful purposes. England has succeeded in doing this, and consequently, the mills of Manchester may render unproductive the mills of Lowell. But reverse the conditions of the two countries, and a similar result attests the truth of the same principle.

**177—Fellow Commoners.** B. U.—Fellow Commoners are "young men of fortune," as the *Cambridge Calendar* and *Cambridge Guide* have it, who, in consideration of their paying twice as much for everything as anybody else, are allowed the privilege of sitting at the Fellows' table in the Hall, and in their seats at Chapel; of wearing a gown with gold or silver lace, and a velvet cap with a metallic tassel; of having the first choice of rooms; and, as is generally believed, and believed not without reason, of getting off with a less number of chapels per week. Among them are included the Honourables *not* eldest sons—only these wear a hat instead of the velvet cap, and are thence popularly known at *Hat* Fellow-Commoners. The nobleman proper or eldest sons (of whom there are never many in Cambridge, Oxford presenting more attractions for them), wear the plain black silk gown and hat of an M.A., except on feast-days and state occasions, when they come out in gowns still more gorgeous than those of the Fellow-Commoners. A Fellow-Commoner of economical habits (and it is not easy for them to be of such habits) requires £500 a year, and for the generality of them £800 is not too much. Indeed, so great is the expense necessarily incurred by this class, to say nothing of their greater temptation to unnecessary expenses, than even eldest sons of peers sometimes come up as Pensioners, and younger sons continually do.

**178—Light.** C. G.—It was Professor Stokes who made the discovery that under certain circumstances a change is effected in the refrangibility of light. His researches took their origin from an unexplained phenomenon discovered by Sir John Herschel, and communicated by him to the Royal Society in 1845. A solution of sulphate of quinine, examined by transmitted light, and held up between the eye and the light, or between the eye and a white object, appears almost as transparent and colourless as water; but when viewed in certain aspects and under certain incidences of light, exhibits an extremely vivid and beautiful celestial blue colour. This colour was shown by Sir John Herschel to result from the action of the strata which the light first penetrates on entering the liquid; and the dispersion of light producing it was named by him epipolic dispersion, from the circumstance that it takes place near the surface by which the light enters. A beam of light having passed through the solution was to all appearance the same as before its entrance; nevertheless, it was found to have undergone some mysterious modification,—for an epipolized beam of light—meaning thereby a beam which had once been transmitted through a quinineous solution, and had experienced its dispersive action—is incapable of further epipolic dispersion. In speculating on the possible nature of epipolized light, Professor Stokes was led to conclude that it could only be light which had been deprived of certain invisible rays, which in the process of dispersion had changed their refrangibility and had thereby become visible.



**179—Music.** O. L.—One of the best things with which to resist the weariness of hard study, is music. Girls who “could not walk a mile to save their lives,” will dance in company with a knock-kneed clarinet and superannuated fiddle, from tea-time till sunrise; while a soldier, grown weary with quietness, will no sooner hear a bugle give a flourish, than he will cut a flourish himself. Whether men can march twenty or forty miles a day, depends altogether on who beats the bass drum.

**180—Conversation.** L. E.—The first ingredient in conversation is truth, the next good sense, the third good humour, and the fourth wit. This last was formerly left to fools and buffoons kept in all great families. Henry IV. of France, and King James I. of England, first gave repute to that sort of wit, increased by King Charles II. In King Charles I.’s time, all wit, love, and honour, was heightened by the wits of that time into romance. Lord Goreign took the contrepied, and turned all into ridicule. He was followed by the Duke of Buckingham; and that vein, favoured by King Charles II., brought it into vogue.

**181—Politeness at Home.** S. A.—Always speak with the utmost politeness and deference to your parents and friends. Some youths are polite and civil everywhere else but at home, but there they are coarse and rude enough. This is shameful. Nothing sits so gracefully upon children and youths, and nothing makes them so lovely, as habitual respect and dutiful deportment towards their parents and superiors. It makes the plainest face beautiful, and gives to every common action a nameless but peculiar charm. “My son, hear the instruction of thy father, and forsake not the law of thy mother, for they shall be an ornament of grace unto thy head, and chains about thy neck.”

**182—Slang.** S. G.—The use of slang phrases, to which so many persons in this country are addicted, is, if not an invariable mark of vulgarity, indicative of low associations at some period of life, and a certain want of dignity and refinement. The young naturally fall into this habit, so offensive to good taste, not only because they have examples in their associates, but because the columns of too many newspapers that fall into their hands, abound with low slang, and the wit and vulgarity of theatre lobbies and street corners. As the use of such terms serves no good purpose whatever, but tends rather to what is low and demoralizing, parents ought especially to discountenance it in their children; and, so far as themselves are concerned, give up the habit if it should have insensibly grown upon them.

**183—Crystal Ornaments.** B. D.—They are easily made. Take one ounce each of alum, of Epsom salts, of white, of blue, and of green vitriol, of Glauber salts, and of sulphate of potash; after they are well crushed, mix together these seven salts, and dissolve them in as little boiling water as can be used to perfectly melt them, which will be about a pint; now place the mixture in a warm situation, where it cannot be affected by dust, or where it will not be agitated. After due evaporation has taken place, the whole will begin to shoot into crystals. Their colour and peculiar form of crystallization will distinguish each crystal separately, and the whole together will form a beautiful and pleasing object; which,

when intended for preservation, should be placed under a glass shade. Any druggist will supply the materials for this experiment for about a shilling.

**184—The European Metallic Domain.** H. A.—The strata of gneiss and mica-slate constitute in Europe the grand metallic domain. There is hardly any kind of ore which does not occur there in sufficient abundance to become the object of mining operations, and many are found nowhere else. The transition rocks, and the lower part of the secondary ones, are not so rich, neither do they contain the same variety of ores. But this order of things which is presented by Great Britain, Germany, France, Sweden, and Norway, is far from being a general law; since in equinoxial America, the gneiss is but little metalliferous; while the superior strata, such as clay, schists, the sienitic porphyries, the limestones, which complete the transition series, as also several secondary deposits, include the great portion of the immense mineral wealth of that region of the globe.

**185—The Character of the North Americans.** D. W.—No, we think that the national character of the American has been greatly misunderstood; few travellers seem, in fact, to have understood it, since they mention it as something as new and unfounded as the country itself, and yet it is so well confirmed—so well established in every elevated and noble characteristic of the human race, that it may confidently be placed in comparison with that of the most celebrated nations of antiquity. Springing originally from England, the Americans have the pride and manly confidence of the Briton, for through their ancestry they claim an equal share of all which gives dignity to those inheriting glory and a great name. Their forefathers were those brave religious pilgrims who were transferred by British laws (or rather by old German) and British genius to the shores of the new world, there to give to those laws and genius an immortality; and their descendants are certainly as shrewd, intelligent and enterprising as any existing commercial people of the present day.

**186—The Human Face divine.** K. A.—The actions of foreign women are seldom to our taste, as lacking what we like the best—reserve. They have usually too much action; tearing their faces to pieces with it, and wearing them up before their time. On the other hand, the faces of the cold-hearted and inanimate seem often to be gifted with a perpetual youth; years roll on, and the skin remains smooth, and the colour bright; but it is at best but a chilly bloom, and betrays the ice that has preserved it. No human face over which suffering and sympathy have passed but must reveal their traces; but there is a fact from which we may gather grateful evidence of the prevalence of joy and gladness over sorrow in the earlier part of life, namely, that the first lines which appear upon the face are almost always found to be graven by the repeated action of smiles and laughter.

**187—The spontaneous Generation of Nitre.** C. E.—The spontaneous generation of nitre in Spain and Egypt, and especially in India, is sufficient to supply the wants of the whole world. There this salt is observed to form upon the surface of the ground in silky tufts, or even in slender prismatic crystals, particularly during the con-

tinuance of the hot weather that succeeds copious rains. These saline efflorescences, after being collected by rude besoms of broom, are lixiviated, allowed to settle, evaporated and crystallized. In France, Germany, Sweden, Hungary, &c., vast quantities of nitrous salts are obtained by artificial arrangements called *nitraries* or nitre-beds. Very little nitrate of potash, indeed, is obtained in the first place; but the nitrates of lime and magnesia, which being deliquescent, remain in the nitrous earths in a semi-liquid state. The operation of converting these salts into good nitre, is often sufficiently complex, in consequence of the presence of several muriates which are difficult to eliminate.

**188—Chemistry.** M.C.—Hour after hour might be employed in recording the triumphs of chemistry in its investigations into the play of the organic elements. Looking back no further than the last few years, you see how it has thrown open the most hidden processes of animal and vegetable life—how it has taught us to increase and economise the food of man. It is even yet the practice of those who have not followed her discoveries into the wondrous affinities of the few simple organic elements, to depreciate the importance of following their infinite creations. If, however, there were no other result from doing so than the one great achievement of having explained the ingredients in food used to build up the muscular frame and those employed in the support of animal heat, the importance of that discovery would have repaid all the labour of the past century. Almost all the staple manufactures of this country are founded on chemical principles, a knowledge of which is absolutely indispensable for their economical application.

**189—Ridicule.** R. O.—We know of no principle which it is of more importance to fix in the minds of young people, than that of the most determined resistance to the encroachments of ridicule. Give up to the world, and to the ridicule with which the world enforces its dominion, every trifling question of manner and appearance; it is to toss courage and firmness to the winds, to combat with the mass upon subjects such as these. But learn, from your earliest days, to insure your principles against the perils of ridicule. You can no more exercise your reason, if you live in constant dread of laughter, than you can enjoy your life, if you are in constant terror of death. If you think it right to differ from the times, and to make a stand for any valuable point of morals, do it, however rustic, however pedantic it may appear: do it, not for insolence, but seriously and grandly—as a man who wore a soul of his own in his bosom, and did not wait till it was breathed into him by the breath of fashion. Let men call you mean if you know you are just; hypocritical, if you are honestly religious; pusillanimous, if you feel you are firm. Resistance soon converts unprincipled wit into sincere respect; and no after-time can tear from you those feelings which every man carries within him who has made a noble and successful exertion in a virtuous cause.

**190—Translation of the Bible.** M. R.—A correspondent desires information respecting the period at which the present English translation of the Bible was first made. The question is more difficult to answer than might be supposed.

Nominally, the present translation was made in the reign of James the First, who appointed a large number of learned men to execute the work, and authorized its publication subsequently by a royal proclamation. But on comparing its style with that of contemporary writers, it becomes evident that the translation was not really made at that time, but that the older translations were merely corrected and improved. The basis of King James' Bible seems, in truth, to have been the Bishop's Bible, first published in the reign of Queen Elizabeth. Many words, which had become obsolete in refined society, were preserved in the present translation, because they were still in use among the unlettered, and in consequence large numbers of such have returned into use. The Bishop's Bible was itself founded on an earlier translation. In fact each successive translator appears to have availed himself of the labour of his predecessors, and the result is a translation which, in point of style, will compare with any ever made. Our correspondent also asks us our opinion as to a new translation. We reply that the advantages to be derived from it, will not equal the disadvantages that will accrue.

**191—Credulity and Reason.** F. G.—Rational belief stands midway between credulity and scepticism; both of which are faults, as well of the understanding as of the temper. Credulity is the error of sanguine, imaginative, and weak minds, which, in their eagerness to receive and hold whatever dazzles the fancy, or moves the sensibilities, or awakens pleasing emotions of wonder and admiration, believe whatever, of this sort, may be presented to them, without inquiring upon what evidence it rests, or perhaps rejecting contrary testimony. It may be noted as a frequent fact, that those who believe the most readily, and in opposition to reason, are the most slow to believe, or hard to be convinced, where evidence is good and abundant. The cause of this is easily assigned. Good evidence appeals to the understanding; but the credulous have, by the long indulgence of their credulity, enfeebled their understandings, and have become actually *incapable* of perceiving the force of argument; at the same time, the fruitless effort which they may make in a single instance to do so, chills and confounds the mind, and dispels those lovely feelings of confidence with which they are wont to entertain other convictions. They can believe only by impulse, not by reason. Scepticism, though apparently an opposite error, not seldom proves itself to be nearly allied to credulity: the reason is, that both spring from infirmity of the understanding, or what might if we were to see a figurative expression, be termed a *paralysis* of the reasoning faculty. By pride, or jealousy, or petulance, or coldness of temper, the habit of distrusting all evidence has been indulged, until it has grown so strong, that even the most conclusive reasons fail to take effect upon the mind: all things appear alike uncertain; a dimness affects the faculties. But as the human mind cannot exist without its convictions, of some sort, it often becomes, in this enfeebled state, the prey of some childish delusions. Many noted sceptics have been absurdly superstitious, or credulous, in certain particulars.



**192—Language.** M.H.L.—Endeavour as much as possible to acquire a true and comprehensive meaning of the words used in your language, and never use any word without perfectly understanding its meaning. Dr. Johnson drove a Billingsgate-fishwoman to the verge of madness by telling her that she was an “individual.” And the following we give as another instance of misapprehension. “Your remarks are crude, sir, very crude!” cried a man to one who styled him a scoundrel. “You have not taken time to weigh your words, or you would never have thought to express yourself in that manner.” “Well, sir, I’ve got proof,” was the reply, “I’ve got proof of what you say. Mr. Brown, you will take notice that this man said I was a *crude*, and I’ll have satisfaction for it, if there’s any law in the country.”

**193—Physical Education.** E. S.—Pure air, a suitable diet, regular exercise and repose, and a proper distribution of time, are the principal means of physical education. It is as essential that a pupil leave his studies during the time appropriated to relaxation, as that he study during the hours devoted to that purpose. Voluntary exercise is to be encouraged by providing suitable games, by affording opportunities for gardening, and by excursions, and by bathing. Regular gymnastic exercises should be insisted on, as the means of developing the body; a healthy action of the bodily frame has an important influence on both mind and morals. Music is to be considered as a branch of physical education, having powerful moral influences. The succession of study, labour, musical instruction, or play, should be carefully attended to. The hours of sleep should be regulated by the age of the pupil.

**194—Fashionable Education.** M. C.—There has of late years sprung up a certain flashy method of educating children, whereby they appear to know a great deal, when, in reality, they have learned nothing thoroughly. Against this brilliant superficiality we enter a most serious protest. We have no objection to the drudgery of learning being lightened, as far as it is possible to be done judiciously, and without impairing the solidity of the boy’s acquirements; but it is the unhappy custom, at many of the fashionable schools and colleges, to confound boys of every grade of mental ability together, to give them a smattering of all the more showy kinds of knowledge, to cram them with what they do not understand, and then to parade them at semi-annual exhibitions, that fond mothers, and foolish fathers, may admire the wonderful aptitude of their children, and applaud, by delusive testimonials, the skill of the teachers. This new style of “learning made easy,” is fraught with the most injurious consequences. It can only result in forming shallow thinkers, narrow reasoners, and pompous dogmatists.

**195—Study and Business.** W.B.—In learning, concentrate the energy of mind principally on the study; the attention divided among several studies is weakened by the division; besides, it is not given to man to excel in many things. But while one study claims your main attention, make occasional excursions into the fields of literature and science, and collect materials for the improvement of your mind, and the advancement of your favourite pursuit. The

union of contemplative habits constructs the most useful and perfect character; contemplation gives relief to action; action gives relief to contemplation. A man unaccustomed to speculation is confined to a narrow routine of action; a man of mere speculation constructs visionary theories, which have no practical utility. Excellence in a profession, and success in business, are to be obtained only by persevering industry. None who thinks himself above his vocation can succeed in it, for we cannot give our attention to what our self-importance despises. None can be eminent in his vocation who devotes his mental energy to a pursuit foreign to it, for success in what we love is failure in what we neglect.

**196—Mathematics.** T. H.—There are numerous steps in the ladder of science, from the accomplished mathematician who sits on the top, and reads mechanics in the Treatise of Poisson, to the child who sits on the lowest round, and learns them by rote from the catechism of Pin-nock. The higher branches of pure and mixed mathematics—without which no one can become a master of natural philosophy—must always be a mystery to the mass of the world. Few have the leisure, the patience, and the talent to unravel their intricacies. The rest must be content with popular works, which are a passport to the spacious and lofty vestibule, but not to the inner shrine. It is a weakness to despise a portion because it is not the whole. The heavens are worth scanning with the naked eye, though the telescope brings new glories into view. But even popular science is a house of many stories, where the lazy visitor gets no further than the ground floor, while the inquisitives make their way to the attics. The guide-books have been adapted to the persons who use them, and some describe a single apartment, some a few of the simplest and most attractive objects, and some conduct us over the entire edifice.

**197—Physiology.** C. R.—The recent progress of the science of Physiology has been nowhere better marked in the literature of this country, than in the works of Dr. Carpenter. Whatever amount of detraction his very successful literary career may have called forth, we know of no works that have so faithfully reflected the progress of Physiology, as his multitudinous writings. One of the earliest works in our language which attempted to embrace in one wide view the physiology of the vegetable and animal kingdoms, and the relation of the two, was his work on “The Principles of General and Comparative Physiology.” Before and since that time, in reviews, papers, articles, and bulky volumes, he has trodden and re-trodden those fields of investigation which have given to the science of Physiology its present character. These works are not characterized so much by original research as by an extensive and accurate acquaintance with the labours of others. Whilst they indicate a patient and laborious inquiry after truth, the facts which they contain are communicated in a clear, earnest, and attractive style. His books on many important points display original thought; and on many subjects he is known to the scientific world as an observer and an experimentalist; these are great qualifications, when so much flimsy knowledge prevails.

**198—How Cities exhaust the Fertility of Land.** D. D.—There has been enough of the elements of bread and meat, wool and cotton, drawn from the surface of the earth, sent to London and buried in the ground, or washed into the Thames, to feed and clothe the entire population of the world or a century, under a wise system of agriculture and horticulture. Down to this day, great cities have ever been the worst desolators of the earth. It is for this that they have been so frequently buried many feet beneath the rubbish of their idols of brick, stone, and mortar, to be exhumed in after years by some antiquarian Layard. Their inhabitants violated the laws of nature, which govern the health of man and secure the enduring productiveness of the soil. How few comprehend the fact that it is only the elements of bread and meat, evolved during the decomposition of some vegetable or animal substance, that poison the air taken into human lungs, and the water that enters the human system, in daily food and drink! These generate pestilence, and bring millions prematurely to their graves. Both pestilence and famine are the offspring of ignorance. Rural science is not a mere plaything for the amusement of grown-up children. It is a new revelation of the wisdom and goodness of Providence, a humanizing power which is destined to elevate man an immeasurable distance above his present condition. To achieve this result, the light of science must not be confined to colleges; it must enter and illuminate the dwelling of every farmer and mechanic. The knowledge of the few, no matter how profound, nor how brilliant, can never compensate for the loss sustained by neglecting to develop the intellect of the many. No government should be wanting in sympathy with the people, whether the object be the prevention of disease, the improvement of land, or the education of the masses. Perhaps one per cent. of the money now annually lost by reason of popular ignorance, would suffice to remove that ignorance.

**199—Effect of Monotony on Health.** T. S.—No man for any length of time can pursue one vocation or one train of thought without mental injury,—nay, without insanity. The constitution of the brain is such that it must have its time of repose. Periodicity is stamped upon it. Nor is it enough that it is awake and in action by day, and in the silence of the night obtains rest and repair; that same periodicity which belongs to it as a whole, belongs, too, to all its constituent parts. One portion of it cannot be called into incessant activity without a permanent injury ensuing. Its different regions, devoted to different functions, must have their separate times of rest. There is a necessity for men of great intellectual endowments, whose minds are often strained to the utmost, to fall back on other pursuits: and thus it will always be that one seeks refuge in the pleasures of quiet country life, another in the chase, another in foreign travel, another in social amusements. Nay, with all men, even those whose lot has been cast in a more lowly condition, whose hard destiny it is to spend their whole lives in pursuit of their daily bread, with one train of thought, and one unvarying course of events, what would become of them if it were not for such a principle as this? Men often say that the pleasures of religion, and of a Christian faith, are wholly prospective, and

to be realized only in another world. In this they make a mistake; for those consolations commence even here, and temper the bitterness of fate. The virtuous labourer, though he may be ground down with the oppressions of his social condition, is not without his relief; at the anvil, the loom, or even at the bottom of the mine, he is leading a double existence—the miseries of the body find a contrast in the calm of the soul—the warfare without is compensated by the peace within—the dark night of life here serves only to brighten the glories of the prospect beyond. Hope is the daughter of despair. And thus a kind Providence, so overrules events, that it matters not in what station we may be—wealthy or poor, intellectual or lowly—a refuge is always at hand, and the mind worn out with one thing turns to another, and its physical excitement is followed by physical repose.

**200—Who was Junius?** W. R.—It is well known that the general opinion, for more than thirty years, has been that Sir Philip Francis was the author of these extraordinary letters. He held a situation in the War-office, at the period the letters began to be published. He obtained a lucrative post in India at the time that the anonymous scribbler ceased to write. His antipathies were, in many respects, those of Junius; his bitterness of spirit somewhat resembled that of the essayist; and other circumstances, familiar to well read-men, increased the evidence. Since his death, Lady Francis has published a letter, in which she asserts that, having once charged him with being Junius, he tacitly admitted the fact. The leading critics and authors of England have heretofore united in attributing these wonderful letters to Sir Philip: Mackintosh, Canning, Campbell, Macaulay and Mahon, all coinciding in this opinion, however much they differed on other subjects. Nevertheless, it is contended that Sir Philip was not the author, and the reasons given for this conviction are certainly weighty. Sir Philip invariably denied the accusation, though he survived to a period when there would have been no peril in the avowal; and the testimony of several of his friends, connections, and relatives, says, that he was so vain a man that, if he had been the author, he could not have concealed the fact even if injury had resulted from it. The letter of Lady Francis, when scrutinized, shows that her husband did not assert the authorship, and that she might readily have misunderstood his enigmatical answer. But not only did Sir Philip deny explicitly, to all others, having written the letters; he also declared that the accusation was an insult to him. Moreover, at the time the letters appeared, Sir Philip was receiving obligations from Lord Chatham, and others assailed by Junius, which he was proud to acknowledge in after life, so that to pronounce him as writer of the letters, involves a charge-against him of the basest ingratitude, backed by the foulest hypocrisy. To crown all, Sir Philip, at no period of his life, produced avowed compositions rivaling those of Junius, though during his controversy with Warren Hastings, he had every stimulant to call forth all his powers. To suppose him the author of these letters is to suppose that, in after life, when his abilities were matured, he suffered a decline in intellectual capacity, which is absurd.



